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ASSISTED BY A COMMITTEE OF COUNCIL.

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THE MINERALOGICAL SOCIETY

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EXCERPT MINUTES OF COUNCIL MEETING.

Held in the Apartments of the Geological Society, June 17th, 1897.

Prof. A. H. Church, F.R.S., in the Chair.

The death of Professor Des Cloizeaux, Foreign Member, was announced.

Professor W. J. Sollas and Mr. E. Woollett were elected Members of the Society.

Prof. Liveing, Mr. Mallet, Mr. Prior, and Mr. Rutley were selected for nomination to replace the four retiring Members of the Council (Prof. Lewis, Mr. Harker, Mr. Watts, and Mr. Tutton).

GENERAL MEETING.

Held in the Apartments of the Geological Society, June 17th, 1897.

N. S. Maskelyne, Esq., F.R.S., President, in the Chair.

Eleven Members were present.

The following papers were read:—

1. On Blödite from the Punjab: by Mr. F. R. Mallet (p. 311).

2. On Monazite and Xenotime in European Rocks: by Mr. Orville A. Derby (communicated by the General Secretary), p. (304).

3. On the identity of Sundtite and Webnerite: by Messrs. G. T. Prior and L. J. Spencer (p. 286).

4. On a new antimonate of iron from Brazil: by Dr. E. Hussak and Mr. G. T. Prior (p. 302).

EXCERPT MINUTES OF COUNCIL MEETING.

Held in the Apartments of the Geological Society, November 16th, 1897.

The deaths of Professor Steenstrup, Corresponding Member, and the Reverend Professor Haughton, Vice-President of the Society, were announced.

Professor E. S. Dana, of Yale College, New Haven, Connecticut, U.S.A., was elected a Corresponding Member.

The Honourable A. J. Strutt, B.A., was elected a Member of the Society.

The following Tuesdays were selected for the dates of Meeting in 1898:—February 1st, April 5th, June 21st, and November 15th (Anniversary).

The Draft Annual Report was amended and approved.

The proposal for an exchange of publications with the Edinburgh Geological Society was accepted.

ANNIVERSARY MEETING.

Held in the Apartments of the Geological Society, November 16th, 1897.

Prof. N. S. Maskelyne, F.R.S., President, in the Chair.

Fifteen Members were present.

The following Report of Council for the Session 1896-7 was read by the General Secretary:—

REPORT.

The Balance Sheet for the year ending December 31st, 1896, which was issued with Number 52 of the Journal, showed that the state of the Finances of the Society continued to be very satisfactory: the Assets (exclusive of the Stock of the Journal and the Library) amounting to £498 0s. 11d., and the Liabilities to £23 1s. 5d. The number of actual Members who had compounded before December 31st, 1895, for the payment of their Annual Subscription was 39.

During the Session 1896-7 there has been one loss by death (the Vice-President, Rev. S. Haughton, M.A., F.R.S.) from the List of Ordinary Members, and the Society has also to regret the deaths of two Corresponding Members, Professors Des Cloizeaux and Steenstrup: on the other hand, Professor E. S. Dana, of Yale College, U.S.A., has been elected a Corresponding Member, and six Ordinary Members have been elected to the Society. The total number of Members is now 134: of these 114 are Ordinary Members, and 20 are Corresponding Members.

Four Meetings have been held during the year, all in London, and (by kind permission) in the Apartments of the Geological Society, Burlington House. The attendances at these Meetings have been 14, 12, 15 and 11, respectively.

Only one Number of the Journal (published in May) has been issued since the last Anniversary Meeting. To this Mr. Prior contributed a preliminary paper recording the occurrence of rocks allied to Monchiquites in the Island of Fernando Noronha, and also analyses of the new minerals Derbylite and Zirkelite discovered by Dr. Eugen Hussak in Brazil. Mr. Spencer described the Satin Spar of Alston, and made some suggestions as to the modes of discrimination of massive fibrous specimens of calcite from those of aragonite : to this author the Society is further indebted for critical accounts of Zinckenite, Wolfsbergite, and Plagionite : his suggestion of the identity of the species Guejarite with Wolfsbergite has since been accepted by Professor Penfield, who was already engaged in the investigation of a mineral supposed to be Guejarite. The number also contains an elaborate paper by Professor O'Reilly on the Micas of the Three Rock Mountain, County Dublin, to which his attention had been attracted by the zonal structure : this paper is illustrated by four fine plates, one of them coloured. Further, Mr. Mallet has recorded the results of his chemical and optical examinations of Nemalite from Afghanistan, and Professor Louis the occurrence of Altaite in Burma. For the numerous Abstracts the Society owes its hearty thanks to Messrs. Harker, Prior and Spencer.

The Council has to congratulate the Society on the continued steady sale of the Journal.

On the motion of the President, seconded by the General Secretary, the Report of the Council was adopted.

Mr. Kitto and Mr. Herbert Smith, having been nominated by the President to act as Scrutineers, reported that 30 voting papers had been returned, and that the following list of Officers and Council had been unanimously approved :—

President.	Prof. N. S. Maskelyne, F.R.S.
Vice-President.	Mr. Hugo Müller, Ph.D., F.R.S.
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	Prof. A. H. Church, M.A., F.R.S.
	Prof. H. A. Miers, M.A., F.R.S.
	Mr. W. J. Pope, F.C.S.
	Prof. G. D. Liveing, M.A., F.R.S.
	Mr. F. R. Mallet, F.G.S.
	Mr. G. T. Prior, M.A., F.G.S.
	Mr. F. Rutley, F.G.S.

Mr. J. H. Collins and Mr. B. Kitto were re-elected Auditors of the accounts of the Society.

Votes of thanks to the Geological Society for the use of its Apartments and to the retiring Members of Council, Professor Liveing, Mr. Mallet, Mr. Prior and Mr. Rutley, were carried with acclamation.

The following Paper was then read:—

On Augelite from a new locality in Bolivia: by Mr. L. J. Spencer, M.A., F.G.S.

Mr. Hutchinson gave an account of an excursion to the Mourne Mountains, with Professor Lewis and a party of students, in search of minerals. Excellent Manebach twins of felspar and specimens of beryl, topaz and other minerals, obtained during the excursion were exhibited.

Prof. Miers gave an account of visits to various districts in Canada, more especially to view a vein of a mineral resembling Albertite, to the nickel formation at Sudbury, and to the gold mines of Kootenay, British Columbia.

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No. 53. DECEMBER 1897. Vol. XI.

On some British Pseudomorphs.

By H. A. Miers, M.A., F.R.S.,

Professor of Mineralogy in the University of Oxford.

[Read April 14th, 1896.]

I. Some British Pseudomorphs, hitherto undescribed.

1. Apatite after Cronstedtite; from Wheal Maudlin, Llanlivery, Cornwall.

A specimen in the British Museum, consisting mainly of brown chalybite and decomposed iron pyrites—the latter mostly converted into earthy oxides—bears upon its surface and in its cavities a number of thin prisms encrusted with a botryoidal yellowish substance which covers a great part of the decomposed specimen. On close inspection the needles are seen to be Cronstedtite, mostly but not entirely converted into black limonite, and the encrusting substance consists mainly of phosphate (with a little carbonate) of lime. The latter is sometimes crystalline on its surface.

2. Calcite after Quartz; from Cork, Ireland.

A specimen in the British Museum collection consists of compact grey limestone, containing small doubly terminated prisms of quartz. These have been converted, some wholly, some partly, into calcite. The change has taken place in zones which follow the contour of the crystals, and sometimes, when the conversion has been almost complete, zones of quartz remain alternating with bands of calcite.

Some of the quartz crystals are entirely unaltered. The change is to a massive calcite rather more white than the surrounding limestone; it appears to have begun sometimes in the interior of the crystal, and to have extended thence towards the surface.

This may be due to the change having spread from zones of enclosed calcite, but the specimen is a true pseudomorph, and not merely an enclosure of calcite in quartz.

The replacement of quartz by calcite has been recorded from Bohemia.

3. Calcite after Celestine (?); from Durham.

Several specimens acquired by the British Museum in 1857 are crystals of a brown colour, embedded in calcareous clay, which were found in the Jarrow Docks at Durham.

These have the form of elongated, doubly terminated, acute rhombic pyramids, with curved faces. They resemble in form the well-known "barley-corn" pseudomorphs from Sangerhausen and from Schleswig, and are almost identical in aspect with a similar pseudomorph from Archangel in Russia.

They also resemble the large pseudomorphs from Hunter River, in New South Wales, described by Dana in the *Geology of the United States Exploring Expedition round the World* (see Liversidge, *Minerals of New South Wales*, p. 161). In my opinion all these crystals are pseudomorphs after celestine, which exhibits a remarkable tendency to crystallise in acute pyramids with curved faces (see Williams, *Am. J. Sci.* XXXIX. 183, 1890, and *cf. Min. Mag.* X. 39).

The specimens from Durham sometimes attain a length of 1½ inch; some are compact, and of a uniform brown colour, and have an unevenly drusy surface, as though etched; others have been completely converted into granular and porous concretions of a yellow calcite.

These pseudomorphs have been known by the name of Jarrowite, but have not hitherto been described, so far as I have been able to ascertain.

4. Cerussite after Lanarkite; from Leadhills, Lanarkshire.

A specimen in the British Museum consists of crystallised cerussite

encrusting altered prisms which have the aspect of lanarkite and consist in the interior of mixed carbonate and sulphate of lead.

This replacement has not been hitherto recorded.

5. Chalcopyrite after Calcite; from Cornwall.

A compact mass of chalcopyrite with rough surface, apparently the apex of a large scalenohedron. So far as can be determined with the hand goniometer, it seems to be that of the common scalenohedron $\{20\bar{1}\}$ of calcite. There is also a little quartz on the specimen.

Such a pseudomorph has not hitherto been recorded.

6. Chalcopyrite after Bismuthite; from Tavistock, Devonshire.

Uneven channelled prisms entirely converted on the surface and to a considerable depth into chalcopyrite. In some instances the core of bismuthite has been partly removed. The accompanying minerals are chalcopyrite, milky quartz and pyrites, upon a matrix of chloritic slate.

7. Chalcopyrite after Bismuthite; from Fowey Consols mine, St. Blazey, Cornwall.

In this specimen the prisms of bismuthite have been entirely converted into a mixture of chalcopyrite and a black material which contains bismuth and sulphur. The pseudomorphs lie for the most part in a matrix, consisting of chloritic slate, quartz, chalcopyrite and erubescite.

The replacement of bismuthite by chalcopyrite has not hitherto been recorded.

Chalcopyrite after Bournonite; from Herodsfoot mine, Liskeard, Cornwall. See No. 13.

8. Chalybite after Bismuthite; from Fowey Consols mine, St. Blazey, Cornwall.

A specimen in the British Museum shows pseudomorphs of chalcopyrite after bismuthite, which have been converted on the surface into a pale blue substance. These are dispersed on chalcopyrite, and they are encrusted with crystallised chalybite. In some instances the altered prisms appear to have been completely replaced by chalybite.

The chalybite lies almost exclusively upon the pseudomorphs, and scarcely at all upon the chalcopyrite.

This replacement has not been hitherto recorded.

9. Chlorite after Mispickel; from Carn Brea, Cornwall.

These are hollow drusy pseudomorphs of chlorite in a form which at first sight appears to be that of the obtuse rhombohedron {110} of calcite. Closer inspection shows that they have the form of mispickel, a combination of the prism {110} with an obtuse macrodome; the prism angle was roughly determined as about 65°. The pseudomorphs are disposed on a matrix of compact chlorite, and are accompanied by a later deposit of tarnished crystals of erubescite and a little chalybite.

The pseudomorph has not hitherto been recorded.

10. Copper after Cuprite; from Cornwall.

A pseudomorphous replacement of cuprite by copper is mentioned by Sillem (*Neues Jahrbuch für Mineralogie*, 1851, p. 385), who gives two localities, namely Penzance and Cuba, but without description.

It is more than probable that his note is based upon two specimens in the British Museum; one of these formerly belonged to the collection of Mr. R. P. Greg, in whose catalogue (dating from the time when the collection belonged to Mr. R. Allan, the catalogue itself having been made by Haidinger) it is entered as from Cuba; the specimen was, however, identified as Cornish, and from Tresavean mine, St. Day, by the late Mr. T. Davies, whose knowledge of Cornish mineral localities was unerring. The other specimen has all the appearance of being Cornish, and was identified by Mr. Davies as from the Relistian mine, Camborne. A third specimen in the British Museum is from Liskeard.

It is remarkable that this pseudomorph is not of more common occurrence. It does not seem to have been described. The characteristics of the specimens are as follows:—

(*a*). Tresavean mine, St. Day. Very perfect cubes and combinations of cube with dodecahedron, consisting of firmly compacted pure copper, but obvious pseudomorphs. The copper, though crystallised, has a drusy and slightly cavernous surface; it is brilliant, and for the most part brightly tarnished.

There is nothing else on the specimen except angular fragments of vein-quartz, a little copper independently crystallised in rounded crystals, and a trace of some black mineral.

There is no regular orientation of the copper in the pseudomorph.

(*b*). Relistian mine, Camborne. Crystals somewhat similar to those in the preceding specimen, accompanied by long blade-shaped crystals of copper. On this specimen the metal is not tarnished, and the matrix

consists of schorl cementing a little fragmentary quartz. The schorl sometimes fills cavities in the mass of copper.

Both these pseudomorphs are complete, and no cuprite remains.

(*c*). Liskeard. A large octahedron of cuprite partly converted into copper.

11. Erubescite after Chalcopyrite; from Cornwall.

These are uneven crystals of very irregular form, but somewhat resembling those from Wheal Towan. They consist partly of chalcopyrite, but have been converted near the surface, and in some instances to a considerable depth, into erubescite.

They are dispersed among quartz crystals, the matrix being clay-slate.

A recently acquired specimen, showing a similar replacement, is from St. Ives Consols mine. Here the resulting substance seems to be a mixture of erubescite and earthy red oxide of copper, and the pseudomorphs are accompanied by crystals of copper glance dispersed upon them, together with a little chrysocolla.

12. Fluor after Calcite; from Derbyshire.

Large scalenohedra of calcite replaced by a mass of cubes of yellowish fluor enclosing chalcopyrite.

These appear to have been epimorphs in which, after removal of the calcite, the cavity has been largely refilled by fluor. Upon one side of the specimen the calcite still remains.

Pseudomorphs of fluor after calcite have previously been described from Breisgau.

13. Galena and Chalcopyrite after Bournonite, from Herodsfoot mine, Liskeard, Cornwall

There are two fine specimens in the British Museum. In these the well-known wheel-shaped groups of bournonite associated with quartz (after barytes) have been corroded and partly replaced by galena, chalcopyrite and tetrahedrite.

The original form of the bournonite tables is well preserved by a thick crust, consisting of large crystals of galena disposed in a regular manner upon the prism faces of the bournonite. The basal surfaces of the bournonite have been for the most part removed, so that the ring of galena surrounds a comparatively thin corroded disc of bournonite, while chalcopyrite and tetrahedrite are dispersed about the cavity so formed and upon the edges of the galena crystals. The tetrahedrite is always

covered with the thin crust of chalcopyrite so familiar in the Herodsfoot specimens.

The galena crystals (which are combinations of cube and dodecahedron) are arranged in such a way that an edge of the octahedron is always parallel to the prism edge of the bournonite; and the general disposition of the crystals suggests that in all probability a cube and dodecahedron face of the galena were parallel to the brachy-pinacoid and the macro-pinacoid respectively of the bournonite.

There is no direct evidence that the galena was not deposited as a crust upon the bournonite prism faces before the decomposition of that mineral; but there is no reason to doubt that the galena, the tetrahedrite and the chalcopyrite have all resulted from the decomposition of the bournonite.

On the other hand, it is remarkable that, whereas bournonite corresponds to a compound consisting of one molecule of tetrahedrite, eight of galena and three of stibnite, there is no trace on these specimens of any antimony compounds such as might be expected to remain after the conversion of bournonite into galena and tetrahedrite.

Sometimes a direct conversion (upon the surface) of bournonite into chalcopyrite has taken place.

A pseudomorph of this nature has not hitherto been described, except from Kapnik.

In Greg and Lettsom's *Mineralogy*, p. 346, it is alluded to as "bournonite filling hollow crystals of galena," a totally false description.

14. Galena after Anglesite; from Derbyshire.

This pseudomorph is only mentioned in Greg and Lettsom's *Mineralogy* (p. 450), without description or locality.

The specimen in the British Museum is from the Allan-Greg collection (see above, No. 10), where it is labelled as from Derbyshire, and has all the appearance of the large crystals formerly found in the neighbourhood of Matlock.

It is a true pseudomorph; the large prism is entirely converted on the surface into a smooth crystalline coating of galena; the alteration has proceeded to a considerable depth, through which the material is a mixture of anglesite and galena; and the interior consists of unaltered anglesite.

There is also a specimen labelled Matlock in the Ludlam collection, now in the Museum of Practical Geology, Jermyn Street.

15. Hæmatite after Fluor; from Lancashire and Cumberland, and St. Just, Cornwall.

The specimens from Furness, Lancashire, are cubes which appear to have been converted into quartz and then covered and partially or entirely replaced by earthy and fibrous hæmatite. They should, therefore, be described as hæmatite after quartz after fluor. Since the cubes do not show the characteristic interpenetrating twinning of fluor, they are often supposed to be pseudomorphs after pyrites, and are so described. In reality the direct replacement of pyrites by hæmatite or by quartz appears to be as rare as that of fluor by silica is common; so that many so-called pseudomorphs of hæmatite after pyrites are doubtless in reality after fluor, which has been altered to silica. This may be true of the specimens from Spitzleite, which closely resemble those from Lancashire and Cumberland. Pyrites is generally transformed into hydrate of iron, and not into hæmatite (see, however, No. 16 below).

On the Lancashire specimens, which are from Dalton-in-Furness and from the Stank mine, the tendency of fibrous hæmatite to form botryoidal and rounded masses has caused the edges and corners of the cubes to become completely rounded on the surface, although the pseudomorph in the interior is generally quite a sharp cube. A central cavity is often partially filled with crystallised calcite.

A specimen from Hodbarrow mine, Millom, Cumberland, precisely resembles those from Lancashire; and similar cubes encrusted with black limonite occur on the specimen from Wheal Owles described below, under No. 22.

These pseudomorphs have not been hitherto described.

16. Hæmatite after Pyrites; from Cumberland.

This specimen is an undoubted example of the conversion of pyrites into hæmatite. The crystals are characteristic combinations of a striated cube with the pentagonal dodecahedron $\pi\{210\}$. They have been entirely converted into a material which, though in the interior of the crystals rather dark coloured for hæmatite, is in reality the anhydrous oxide, since it only loses 0·3 per cent. of its weight on ignition.

Similar pseudomorphs from Torquay, Devonshire, have been described by Solly and Hutchinson in this Magazine (Vol. VIII., 1889, p. 183).

A replacement of pyrites by hæmatite from Donegal has also been recorded (without description) in Hall's *Mineralogist's Directory*.

17. Hæmatite after Calcite; from Furness, Lancashire.

These specimens, from the Stank mine, are scalenohedra completely replaced by earthy and fibrous red hæmatite. The edges and corners of the pseudomorphs are rounded in the same way as in those of hæmatite after fluor.

18. Hæmatite and Limonite after Calcite; from Bristol.

A flat surface of sharply crystallised scalenohedra twinned upon the basal plane, resembling in aspect the well-known pseudomorphs from Spitzleite.

The only British localities previously recorded for this replacement are Cornwall (in Greg and Lettsom, p. 249) and Parkside mine. Cumberland (in Hall's *Mineralogist's Directory*).

The replacing material is partly limonite, and in one specimen consists mainly of limonite. Here the fibrous structure shows that the original pseudomorph was hæmatite after calcite, and that the hæmatite has been converted into limonite.

19. Hæmatite and Redruthite after Pyrites; from St. Just, Cornwall.

A group of large cubes entirely converted into a material which consists mainly of crystalline hæmatite, but contains also a proportion of copper which appears to be present, partly at least, as redruthite. The specimen is from the Levant mine. Another specimen from Cornwall is a large cube coated with earthy melaconite. The interior is a compact mineral containing sulphur, iron and copper, possibly also a mixture of hæmatite and redruthite.

Limonite after Calcite; from Bristol. See No. 18.

20. Limonite after Cronstedtite; from Wheal Jane, Truro, Cornwall.

In some of these specimens the typical crystals of cronstedtite have been completely transformed into limonite.

The pyrites upon which they were situated has also been altered to limonite, but only to a very slight depth, below which the material is quite unaltered.

This replacement has not previously been recorded.

21. Limonite after Fluor; from Redruth, Cornwall.

Cubes of black limonite, with rounded edges and corners, from Cook's Kitchen mine, seem to be in all probability pseudomorphs after fluor. Where these have been broken the original substance is found to have been entirely removed, and the fibrous structure of the enveloping substance shows that it was formerly hæmatite. The cubes are therefore to be described as hæmatite epimorphs after fluor, which have been converted into limonite. The limonite also encrusts accompanying crystals of quartz.

Sharp cubes consisting of a mixture of quartz and limonite from Wheal Owles, St. Just, may also be pseudomorphs after fluor. The centre of the cubes consists mainly of granular quartz.

22. Limonite after Hæmatite; from Wheal Owles, St. Just, Cornwall.

The specimen referred to above (under 15) consists mainly of sharp cubes, consisting of quartz (pseudomorphs after fluor) coated or superficially replaced by limonite. These are accompanied by crystals having the form of hæmatite, which have been completely transformed into limonite.

The replacement has only been previously recorded by Collins (*Min. Cornwall and Devon*, p. 80), on doubtful authority, as from Restormel.

23. Magnetite after Picrolite; from Scalpa, Isle of Harris, in the Hebrides.

In a specimen of picrolite from this locality the fibres have been largely converted into magnetite, in which the structure of the original mineral is well preserved.

The specimen somewhat resembles one from Piedmont, in which a similar replacement has taken place. It has not been previously recorded from a British locality.

24. Malachite after Cerussite; from Redruth, Cornwall.

A specimen in the British Museum, formerly belonging to the Allan-Greg Collection, consists of a mass of small green crystals upon a quartzose matrix. The crystals consist entirely of malachite, but they have the form of rhombic tables with bevelled edges sometimes irregularly grouped together, but sometimes twinned like cerussite. Some of the crystals also have the aspect of acute pyramids. Mr. G. F. H. Smith has kindly measured some of these crystals, and finds their angles to be approximately those of cerussite. The locality is mentioned by Hall.

Marcasite after Pyrrhotite; from Cornwall. See No. 28.

25. Plumbo-resinite after Barytes and Pyromorphite; from Roughten Gill, Cumberland.

Familiar in most old collections are the specimens from Roughten Gill, in which pyromorphite in crystals or botryoidal groups lies upon a sky blue mineral encrusting the matrix. The blue mineral is probably generally regarded as silicate or carbonate of zinc.

On one specimen in the British Museum, which formerly belonged to the Allan-Greg collection, the blue mineral encrusts thin tabular crystals of barytes, and upon the epimorph are dispersed small yellow crystals of pyromorphite. Greg and Lettsom mention carbonate of zinc after barytes without the locality, and the label which accompanies the specimen leaves no doubt that this is the specimen to which their allusion refers.

The blue mineral was found by Mr. Prior to be neither carbonate nor silicate of zinc, but the phosphate of lead and aluminium known as plumbo-resinite.

The occurrence of plumbo-resinite at Roughten Gill is first mentioned in the 3rd edition of Dana's *System* in 1850. It is not mentioned in the 2nd edition of 1844.

Plumbo-resinite pseudomorphous after barytes has not hitherto been recorded.

The elaborate description in Blum's *Pseudomorphosen*, Vol. I. p. 273, of pseudomorphs of silicate of zinc after pyromorphite from Caldbeck Fell probably relates to this substance.

26. Pyrites after Barytes; from Liskeard, Cornwall.

This pseudomorph is mentioned by Collins, from Herodsfoot mine, on the authority of Pearce, but has not been described.

The British Museum collection contains several specimens of well-defined hollow epimorphs of pyrites; in no case is any trace of the original mineral remaining, and the only evidence of its nature is the characteristic form of the rhombic tables, a combination of {001} and {110} so familiar in barytes. On one specimen from Wheal Trelawney, which consists practically of a continuous crystal of pyrites completely covered with sharp impressions of barytes crystals, the prism angle bounding the tabular hollows could be measured from the sides of the casts by the reflecting goniometer, and was found to be 78°30′.

On the other specimens the epimorphs consist of small cubes of

pyrites massed together irregularly. A somewhat similar specimen from Tavistock seems to consist of marcasite.

There is also a specimen from Liskeard in the Jermyn Street Museum.

27. Pyrites after Barytes; from Cumberland.

This consists of a large hollow epimorph of the same form as the preceding, and composed of small polysynthetic cubes of pyrites. The hollow has been entirely filled with drusy prisms of milky calcite, a combination of $\{2\bar{1}\bar{1}\}$ and $\{110\}$. The calcite is also dispersed over the surface of the epimorph.

This occurrence has not been previously described.

28. Pyrites and Marcasite after Pyrrhotite; from Cornwall.

These pseudomorphs are thin hexagonal plates, consisting entirely of cubes of pyrites which have completely replaced the original mineral. They are implanted upon a matrix consisting of blende and massive pyrites. The associated minerals are a little quartz and pearlspar. The cubes of pyrites which constitute each hexagonal plate are for the most part arranged in regular position, and parallel to each other.

In one specimen from Wheal Seaton, Camborne, the pseudomorphs are beautiful hollow plates with a drusy surface, and with large pyramid faces.

Another Cornish specimen shows the plates in the more characteristic form of low hexagonal pyramids, but the material here appears to be marcasite. These are associated with blende. These pseudomorphs have not been described before; they are well known from Freiberg.

A specimen in the Jermyn Street Museum is from Redruth.

29. Pyrites after Quartz and Fluor; from Cornwall.

An epimorph in which pyrites, in thickly accumulated somewhat rounded and drusy crystals, completely encrusts milky quartz. These are accompanied by large hollow octahedral epimorphs, possibly after fluor, from which the original mineral has been entirely removed, leaving only small milky crystals of quartz upon which the original octahedra were deposited.

The specimen was originally in the Allan-Greg collection, and the locality is given on the authority of the label which accompanies it.

Pyrites after quartz has not hitherto been recorded among British pseudomorphs, and pyrites after fluor only from Alston.

30. Quartz after Barytes; from Liskeard and Devonshire.

Pseudomorphs of chalcedony after barytes are mentioned by Greg and

Lettsom as having been recently found at Herodsfoot mine and Wheal Mary, in Cornwall; and quartz after barytes from Durham is recorded by Hall.

Excellent pseudomorphs of quartz after barytes are common from Herodsfoot mine at Liskeard, accompanying bournonite. These appear to have been originally epimorphs of quartz after very thin tabular plates of barytes, in which the barytes has been subsequently removed and replaced by quartz. There is no trace of barytes left upon these specimens.

Epimorphs of quartz after barytes also occur at Wheal Mary Ann, Liskeard, and probably also in Devonshire.

It is remarkable that these epimorphs have not been previously described.

31. Quartz after Barytes (?); from Blackwell Down, Somersetshire.

Two specimens in the British Museum from this locality consist of a fibrous mineral which has been entirely replaced by quartz. The fibres are curved and show a tendency to arrange themselves into radiating groups, and are pinkish in colour. Mr. Prior has kindly examined one of these specimens at my request, and finds it to contain barium.

The mineral overlies quartz on a matrix of quartzose ironstone. Blackwell is one mile south-east of Nailsea, and seven miles south-west of Bristol.

32. Quartz after Bournonite; from Liskeard, Cornwall.

Among the metallic minerals upon which quartz is deposited bournonite is conspicuous. On the specimens from Liskeard the wheel-shaped groups of bournonite are frequently plated with a layer of quartz. In one specimen from the Herodsfoot mine the bournonite has been partly removed or converted into a mixture of galena and chalcopyrite, as described above under 13, and the result is a hollow epimorph of quartz after bournonite.

This has not been previously recorded.

33. Quartz after Silver; from Cornwall.

A specimen from the Allan-Greg collection, labelled Cornwall, consists of quartz crystals, among which are dispersed groups of crystallised chalcopyrite, accompanied by overlying crystals of marcasite. A still later deposit of quartz is a mass of wiry form, which, on close examination, is seen to consist of minute crystals completely enveloping fine threads of black mineral, to which the wiry form is due. The mineral

appears to be argentite, doubtless itself a pseudomorph after native silver.

The large quartz crystals which constitute the main part of the specimen are themselves overlaid with a deposit of secondary quartz, which lies smoothly on the pyramid faces, but gives a drusy surface to the prism faces; and upon them are scattered a few hollow pseudomorphs of quartz after curved rhombohedra of calcite (or dolomite).

The history of this interesting specimen is very clearly told by the succession of minerals. The original minerals were quartz succeeded by chalcopyrite, marcasite, chalybite and native silver in order. The silver has been converted into argentite. Then has come a secondary deposit of quartz, which has completely coated the chalybite and the argentite, and has increased the earlier quartz crystals, but has almost absolutely avoided the other metallic minerals.

This specimen illustrates the value of a study of epimorphs as indicating the tendency exhibited by a given mineral to crystallise only upon certain minerals, and not upon others. In this connection the reluctance of quartz to crystallise upon the metallic minerals is strikingly conspicuous. A survey of any mineral collection brings this fact to light at once; and among the very complete list of pseudomorphs enumerated in the first volume of Roth's *Allgemeine und chemische Geologie*, the only pseudomorph of quartz after a metallic mineral mentioned is that after galena. Pseudomorphs of quartz after pyrites recorded by Carne[1] are not supported by any other authority (see below, p. 279).

Epimorphs of quartz after silver or argentite have not been previously recorded.

A specimen in the British Museum collection from Freiberg presents a precisely similar encrustation by quartz of wiry silver altered into argentite.

Redruthite after Pyrites; from St. Just, Cornwall. See No 19.

34. Redruthite after Erubescite; from Redruth, Cornwall.

A specimen in the Ludlam collection, now in the Museum of Practical Geology, Jermyn Street, appears to be a single cube of erubescite in a quartz geode, converted into redruthite.

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[1] *Trans. Roy. Geol. Soc. Cornwall*, 1846, VI. 28.

II. British Pseudomorphs for which the evidence is insufficient or incorrect.

(*Many of these may be genuine, and it is hoped that their present provisional separation may lead to the re-identification of such*).

Analcime after Calcite is recorded by Greg and Lettsom, but without description.

Aragonite after Witherite is recorded by Greg and Lettsom, but without description or locality.

Barytes after Analcime is recorded by Greg and Lettsom, but without description or locality.

Bournonite after Galena, from Herodsfoot mine; recorded by Greg and Lettsom; see above, No. 13.

Calamine after Barytes is Plumbo-resinite after Barytes (see above, No. 25).

Calamine after Galena is recorded by Greg and Lettsom, but without description or locality.

Chalcopyrite after Blende, from Cornwall, is recorded by Greg and Lettsom, and also by Collins and by Hall, but the evidence seems doubtful.

Chalcopyrite after Chalybite is mentioned by Greg and Lettsom without description or locality, and by Hall as from St. Just.

Chalcopyrite after Dolomite is recorded by Carne as from Huel Tolgus, and is mentioned by Collins, but the evidence in favour of this being a psuedomorph is insufficient.

Chalcopyrite after Pyrites (in cubes) is mentioned by Carne, but the statement is not repeated by Collins, and has no further evidence to support it.

Chalybite after Galena is recorded by Greg and Lettsom, but without description or locality.

Chalybite after Selenite, from Devonshire, recorded by Greg and Lettsom, is probably after Barytes.

Chlorite after Albite is recorded by Collins, but without description.

Chlorite after Fluor is recorded by Greg and Lettsom, but without description or locality.

Chlorite after Garnet is recorded by Greg and Lettsom, but without description or locality.

Chrysocolla after Cerussite and Galena, from Leadhills; recorded by Greg and Lettsom.

Chrysocolla after Cupro-uranite, from Cornwall, is recorded by Greg and Lettsom, but requires confirmation.

Cuprite after Chalcopyrite is recorded by Greg and Lettsom, but without description or locality.

Fluor after Felspar is recorded by Collins, on the authority of Pearce.

Galena after Barytes is recorded by Greg and Lettsom, without description or locality.

Green-earth after Barytes is recorded by Greg and Lettsom, but without description or locality.

Hæmatite after Barytes, from Ulverstone, is recorded by Greg and Lettsom, but requires confirmation.

Hæmatite after Galena is recorded by Greg and Lettsom, but without description or locality.

Hæmatite after Marcasite is recorded by Greg and Lettsom, but without description or locality.

Hemimorphite after Pyromorphite is Plumbo-resinite after Pyromorphite (see above, No. 25).

Kaolin after Fluor is recorded by Greg and Lettsom, but without description or locality.

Limonite after Dolomite is recorded by Collins on the authority of Pearce, but requires confirmation.

Limonite (?) after Felspar, from Carnmouth, is recorded by Collins, but requires confirmation.

Limonite after Psilomelane, from Hoy in the Orkneys, is recorded by Greg and Lettsom; but see *Min. Mag.*, iii., 237.

Limonite after Staurolite, from Ireland, the so-called Crucite, has been shown to be after mispickel.

Magnetite after Pyrites, from Tarbet, is recorded by Hall, but requires confirmation.

Malachite after Chalcopyrite is recorded by Greg and Lettsom, but without description or locality.

Malachite after Linarite, from Red Gill, Caldbeck, Cumberland. A specimen of altered linarite in the Jermyn Street Museum may be an example of conversion into Malachite.

Marcasite after Calcite. This pseudomorph is mentioned by Greg and Lettsom from the "Tamar mines, Beerferris, Devonshire, in low hexagonal prisms, slightly modified." There is a specimen in the Greg collection answering to this description, but labelled Cornwall; and there

is no such specimen from Beerferris. It seems to be one of the pseudomorphs described above, under 28, as after pyrrhotite.

Marcasite after Dolomite, from Liskeard. A specimen in the British Museum may be a pseudomorph after dolomite.

Mica after Pinite is recorded by Greg and Lettsom, but without description or locality; there is no evidence that it differs from the nacrite after pinite, mentioned below.

Mispickel after Albite is recorded by Greg and Lettsom without description or locality, and as doubtful. Collins mentions a pseudomorph of pyrites after Albite, from the Consolidated Mines, without description.

Nacrite after Pinite is recorded by Greg and Lettsom, but without description or locality.

Plattnerite after Pyromorphite, from Leadhills; recorded as doubtful by Greg and Lettsom.

Prehnite after Quartz is recorded by Greg and Lettsom, but without description or locality.

Prehnite after Scolecite is recorded by Greg and Lettsom, but without description or locality.

Pyrites after Blende is recorded by Greg and Lettsom, without description or locality.

Pyrites after Chalybite is recorded by Collins, without description or locality.

Pyrites after Coal is recorded by Greg and Lettsom, without description or locality.

Pyrites after Galena is recorded by Greg and Lettsom, without description or locality.

Quartz after Anglesite is recorded by Greg and Lettsom, but without description or locality.

Quartz after Datolite, so called Haytorite, has been shown to be chalcedony after datolite.

Quartz after Felspar, from Boscagel Downs; recorded by Carne.

Quartz after Galena is recorded by Greg and Lettsom, but without description or locality.

Quartz after Hæmatite, from Huel Edward, is described as an epimorph by Carne; it is not quoted by Collins, and requires confirmation.

Quartz after Pyrites, from North Roskear, has been recorded by Carne (octahedral quartz); it is not quoted by Collins, and requires confirmation.

Redruthite after Copper is recorded by Greg and Lettsom, without description or locality.

Salt after an unknown mineral is recorded by Collins (see the description by Ormerod).

Steatite after Barytes is recorded by Greg and Lettsom, but without description or locality.

Talcite after Andalusi e, from Wicklow (?), is recorded by Hall.

Uranium-ochre after Uranite is recorded by Greg and Lettsom, but without description or locality.

Vanadinite after Hemimorphite is recorded by Greg and Lettsom, but without description or locality.

III. Preliminary list of British Pseudomorphs which may be regarded as established on fairly satisfactory evidence.

In this list the known existence of a specimen is recorded in preference to evidence which may be found in the literature; many occurrences are here accepted on the authority of a competent observer where the locality is definitely stated, even though not described.

Albite after Analcime, from Edinburgh and Kilpatrick; recorded by Greg and Lettsom.

Albite after Laumontite from Edinburgh; in the British Museum; recorded from Kilpatrick by Greg and Lettsom.

Albite after Stilbite, from Kilpatrick; in the British Museum.

Amphibole after Augite, from Wales; see Harker, *Min. Mag.* VIII. 32.

Analcime after Laumontite, from Kilmalcolm, Renfrewshire; in the British Museum.

Analcime after Prehnite, from Paisley, Renfrewshire; recorded by Hall.

Apatite after Cronstedtite, from Wheal Maudlin, Cornwall; see above, No. 1.

Barytes after Barytocalcite, from Alston; in the British Museum.

Barytes after Witherite, from Hexham and Dufton; in the British Museum; see Greg and Lettsom, and *Neues Jahrb. f. Min.* 1895, I. 252.

Bindheimite after Jamesonite, from Endellion, Cornwall; specimens of jamesonite in the British Museum are altered into a brown mineral, probably a mixture of various oxides of antimony as described by Brooke from Lostwithiel, and by Sillem.

Calamine after Fluor, from Derbyshire; in the British Museum.

Calamine after Calcite, from Matlock, and from the Mendips; in the British Museum.

Calcite after Aragonite, from Eskett, Ennerdale, Cumberland. A specimen in the Ludlam collection, Jermyn Street Museum.

Calcite after Celestine (?), from Jarrow; see above, No. 3.

Calcite after Galena, from Wanlockhead; recorded by Greg and Lettsom.

Calcite after Leadhillite, from Leadhills; recorded by Greg and Lettsom.

Calcite after Quartz, from Cork; see above, No. 2.

Cassiterite after Felspar, from St. Agnes; well known in all collections; this replacement is also recorded from St. Austell by Collins; see *Min. Mag.* IV. pp. 8, 112.

Cassiterite after Quartz, from St. Agnes; the so-called stannite.

Cerussite after Anglesite, from Leadhills; in the British Museum; there is also a specimen from Derbyshire which may be after anglesite.

Cerussite after Galena, from Leadhills; in the British Museum; the replacement is also recorded from Cornwall by Carne.

Cerussite after Lanarkite, from Leadhills; see above, No. 4.

Cerussite after Leadhillite, from Leadhills; in the British Museum; the pseudomorph is a mixture of cerussite and pyromorphite.

Cervantite after Stibnite, from Eskdale; recorded by Hall.

Chalcedony after Barytes, from Cornwall; recorded by Greg and Lettsom.

Chalcedony after Datolite, from Haytor, Devonshire; well known as haytorite; also recorded from North Roskear mine by Greg and Lettsom.

Chalcedony after Calcite, from Liskeard, in Cornwall, and from Haytor, in Devonshire; both these localities are represented in the British Museum.

Chalcedony after Dolomite, from Penzance and Redruth, in Cornwall; in the British Museum.

Chalcedony (or Hornstone) after Fluor, from Menheniot, in Cornwall, and from Beeralston, in Devonshire; both these localities are represented in the British Museum; the latter are well known.

Chalcopyrite after Bismuthite, from Fowey, Cornwall, and Tavistock, Devonshire; see above, Nos. 6 and 7.

Chalcopyrite after Bournonite, from Liskeard; see above, No. 13.

Chalcopyrite after Calcite, from Cornwall; see above, No. 5.

Chalcopyrite after Redruthite, recorded by Greg and Lettsom; and by Collins from Cornwall; in the British Museum from St. Just.

Chalcopyrite after Tetrahedrite, from Herodsfoot mine, Liskeard; these beautiful pseudomorphs due to superficial alteration are common in all collections. This replacement is recorded from the Levant mine by Greg and Lettsom; in the British Museum from St. Austell.

Chalybite after Barytes, from Virtuous Lady mine, Tavistock, Devonshire; these hollow epimorphs are familiar in all collections.

Chalybite after Bismuthite, from Fowey, Cornwall; see above, No. 8.

Chalybite after Calcite, from Marazion, Cornwall; in the British Museum; recorded from Beeralston, Devonshire, by Greg and Lettsom.

Chalybite after Dolomite, from Wheal Owles, St. Just, Cornwall; recorded by Collins.

Chalybite after Fluor, from Virtuous Lady mine, Tavistock, Devonshire; these hollow epimorphs are also well known, and are fully described by Blum; in the British Museum is also a specimen from Alston, Cumberland; and it is recorded from Wheal Maudlin, Cornwall, by Greg and Lettsom, and from Fowey by Hall.

Chalybite after Pyrites, from Devonshire; in the British Museum, and recorded by Greg and Lettsom.

Chlorite after Axinite, from Dartmoor: in the British Museum; described by Blum.

Chlorite after Felspar, and Magnetite, from Cornwall; recorded by Collins.

Chlorite after Mispickel, from Carn Brea, Cornwall; see above, No. 9.

Chrysocolla after Chalcophyllite, from Wheal Unity (?), Cornwall; a specimen in the Jermyn Street collection consists of hexagonal plates of chalcophyllite completely converted into chrysocolla.

Chrysocolla after Chalybite, from Roughten Gill, Cumberland; a specimen in the Jermyn Street collection appears to be rhombohedra {100} converted into chrysocolla.

Chrysocolla after Cuprite, from Cornwall; in the British Museum; these pseudomorphs generally consist of a mixture of chrysocolla and malachite; the best specimens are from Wheal Phœnix, Liskeard; they sometimes have globular phosphate of copper dispersed upon them.

Chrysocolla after Felspar, from Cornwall; Semmons, *Min. Mag.* II. 200.

Chrysocolla after Malachite, from Roughten Gill; a specimen in the Jermyn Street collection.

Copper after Cuprite, from Cornwall; see above, No. 10.

Covelline after Chalcopyrite, from Wheal Maudlin, Cornwall; recorded by Greg and Lettsom.

Covelline after Harrisite, from Wheal Falmouth; Davies, *Min. Mag.* I. 113.

Dolomite after Calcite, from Cornwall, and from Beeralston and Tavistock, in Devonshire; in the British Museum.

Erubescite after Chalcopyrite, Cornwall; see above, No. 11.

Erubescite after Redruthite, from Redruth, Cornwall; recorded by Greg and Lettsom, but not by Collins; there are specimens in the British Museum; see the description in Blum. A specimen from Wheal Damsel in the Jermyn Street Museum appears to consist of a mixture of erubescite and copper pyrites.

Ferrite after Augite, from Scotland; see Heddle, *Min. Mag.* V. 28, VII. 134.

Fluor after Calcite, from Derbyshire; see above, No. 12.

Fluor after Quartz, from Trowlesworthy Tor, Devonshire; Bonney, *Min. Mag.* vi. 48.

Galena after Anglesite, from Derbyshire; see above, No. 14.

Galena after Bournonite, from Liskeard; see above, No. 13.

Galena after Pyromorphite, from Wheal Hope, Truro, Cornwall. These pseudomorphs (formerly known as "Blue Lead") are well-known

Gilbertite after Quartz, and Orthoclase, Cornwall; see Solly, *Min. Mag.* VII. 141; Collins, ii. 94.

Göthite after Pyrites, from the Restormel Mines, Cornwall; recorded by Collins.

Green-earth after Augite, and Calcite, from Kilpatrick; recorded by Hall and by Greg and Lettsom.

Hæmatite after Calcite, from Furness and Bristol; see above, Nos. 17, 18.

Hæmatite after Chalybite, from Cornwall; *Min. Mag.* ii. 94.

Hæmatite after Fluor, from Furness, Millom and Redruth; see above, Nos. 15, 22.

Hæmatite after Pyrites, from Cumberland and Devonshire; see above, No. 16.

Hemimorphite after Calcite, from Matlock, Derbyshire; recorded by Hall; see Allan's *Mineralogy*, p. 44.

Hemimorphite after Galena, from Wanlockhead; recorded by Greg and Lettsom.

Hemimorphite after Vanadinite, from Wanlockhead; recorded by Greg and Lettsom.

Kaolin after Felspar, from Cornwall.

Kyanite after Staurolite, from Wicklow, Ireland; recorded by Greg and Lettsom.

Laumontite after Analcime, from Kilpatrick, Dumbartonshire; in the British Museum.

Limonite after Calcite, from Bristol; see above, No. 18.

Limonite after Chalybite, from St. Just, Cornwall; there is a specimen in the British Museum from Botallack mine; this occurrence is recorded by Carne; the same replacement is also recorded from Mawddach in Wales, see *Min. Mag.* III. 127.

Limonite after Cronstedtite, from Truro; see above, No. 20.

Limonite after Fluor, from Redruth; see above, No. 21.

Limonite after Garnet, from Belstone, Devonshire; recorded by Collins on the authority of Davies.

Limonite after Göthite, from Restormel, Lostwithiel, Cornwall; recorded by Greg and Lettsom.

Limonite after Hæmatite, from St. Just; see above, No. 22.

Limonite after Marcasite, from Dorset, Lewes in Sussex, Moneyash in Derbyshire, St. Just in Cornwall; specimens from all these localities are in the British Museum. The pseudomorph is recorded from Stromness, in the Orkney Islands, by Greg and Lettsom; see also *Min. Mag.* III. 224.

Limonite after Mispickel, from Clonmel, Co. Waterford, Ireland; the so-called "crucite" common in all collections.

Limonite after Pyrites, from Cornwall, and from Hoy, is recorded by Greg and Lettsom, by Carne and by Heddle.

Magnetite after Picrolite, from Scalpa, Hebrides; see above, No. 23.

Magnetite after Cerussite, from Redruth, Cornwall; see above, No. 24.

Malachite after Chalcophyllite, from Camborne, Cornwall; recorded by Semmons in *Min. Mag.* VI. 162.

Malachite after Cuprite, from Redruth, Cornwall; in the British Museum.

Marcasite after Barytes, from Tavistock, Devonshire; see above, No. 26.

Marcasite after Pyrrhotite, from Cornwall; see above, No. 28.

Nacrite after Andalusite, from Wicklow, Ireland; recorded by Greg and Lettsom; Hall calls it talcite.

Olivenite after Quartz, from Marke Valley mine, Liskeard, Cornwall; an epimorph in the British Museum.

Olivine after Sphene, from Sutherland; Heddle, *Min. Mag.* V. 189.

Pectolite after Analcime, from Edinburgh; in the British Museum.

Pinite after Cordierite, from Cornwall, Perth and Dublin; see Collins, *Min. Mag.* X. 8. There are specimens from Cornwall in the British Museum.

Plumbo-resinite after Barytes and Pyromorphite, from Roughton Gill, Cumberland; see above, No. 25.

Prehnite after Analcime, from Hartfield, and from Kilpatrick; in the British Museum.

Prehnite after Pectolite, from Edinburgh; in the British Museum.

Pseudophite after Labradorite, from Aberdeen; Heddle, *Min. Mag.* III. 138.

Pyrites after Barytes, from Cornwall and Cumberland; see above, Nos. 26 and 27.

Pyrites after Calcite, from Herodsfoot mine, Liskeard, Cornwall; recorded by Collins; there is a specimen in the British Museum consisting of marcasite and pyrites. It is also recorded by Greg and Lettsom from Tavistock.

Pyrites after Fluor, from Alston, is mentioned by Greg and Lettsom, p. 280; from Cornwall, see above, No. 29.

Pyrites after Pyrrhotite, from Cornwall; see above, No. 28. A specimen in the Jermyn Street Museum is labelled Redruth.

Pyrites after Quartz, from Cornwall; see above, No. 29.

Pyromorphite after Barytes, from Leadhills; in the British Museum.

Pyromorphite after Galena, from Leadhills; in the British Museum.

Pryomorphite after Leadhillite, from Leadhills; in the British Museum (the pseudomorph is a mixture of pyromorphite and cerussite).

Quartz after Barytes, from Liskeard, from Devonshire, from Somerset, and from Durham; see above, Nos. 30, 31.

Quartz after Bournonite, from Liskeard; see above, No. 32.

Quartz after Calcite, from Gwennap, from Botallack mine in St. Ives, from East Pool Mine in Redruth, and from Bodmin, Cornwall (Fowey Consols, Jermyn Street Museum); from Clifton and from Haytor; specimens from some of these localities are in the British Museum, the others are recorded by Greg and Lettsom and by Hall. In a very perfect specimen from Wheal Alfred in the Jermyn Street Museum curved polysynthetic rhombohedra are completely replaced by clear quartz.

Quartz after Chalybite, from Redruth, Cornwall; there is a specimen in the British Museum; it is also recorded from Botallack mine by Carne.[1] From Cook's Kitchen mine (Ludlam collection).

Quartz after Dolomite, from St. Just, Cornwall, and from the Orkneys; recorded by Greg and Lettsom; from Trevartha (Ludlam collection).

Quartz after Fluor, from Wheal Alfred and Botallack mine, and from Caradon (Ludlam collection) in Cornwall, from Devonshire, from Alston, from Clifton, from Shropshire, and from Durham; some in the British Museum, and the others recorded by Greg and Lettsom, and by Hall.

[1] *Trans. Roy. Geol. Soc. Cornwall*, 1822, II. 307.

Quartz after Orthoclase, from St. Austell, Cornwall; recorded by Collins; *Min. Mag.* i. 57.

Quartz after Silver, from Cornwall; see above, No. 33.

Quartz after Stilbite, from Kilpatrick (recorded by Greg and Lettsom), and from Dumbarton (in the British Museum). This seems to be a complete replacement of the mineral by quartz.

Redruthite after Galena, from Perran, Cornwall; see *Min. Mag.* Vol. I. p. 114. The specimen is in the British Museum.

Redruthite after Pyrites, from St. Just, Cornwall; see above, No. 19.

Redruthite after Erubescite, from Redruth, Cornwall; see No. 34.

Sandstone, Shale and Clay after Salt, from Cheshire; recorded by Greg and Lettsom.

Saponite after Calcite, from Derry, Ireland; recorded by Greg and Lettsom.

Scheelite after Wolfram, from East Pool mine, Cornwall; see Collins, *Min. Mag.* II. 92, and *Handbook to the Mineralogy of Cornwall and Devon.*

Serpentine after Pyroxene and Amphibole from Scotland; see Heddle, *Trans. Roy. Soc. Ed.* 28, pp. 491, 501, 530.

Steatite after Analcime, from Edinburgh; recorded by Greg and Lettsom.

Steatite after Faroelite, from Magee Island, Antrim; recorded by Hall.

Steatite after Felspar, from Wheal Coates, St. Agnes, Cornwall; in the British Museum.

Steatite after Pectolite, from Ratho, Edinburgh; in the British Museum; see Heddle, *Phil. Mag.* XVII. 46.

Tourmaline after Felspar, from Cornwall; recorded by Collins.

Vanadinite after Galena, from Wanlockhead; recorded by Greg and Lettsom.

Wad after Calcite, from Leadhills; recorded by Greg and Lettsom.

Witherite after Barytes, from Dufton; recorded by Greg and Lettsom.

Wolfram after Scheelite, from Wheal Maudlin; in the British Museum.

For fuller references to the literature, and for additional mines, see Collins, *Handbook to the Mineralogy of Cornwall and Devon*, p. 80, and Spencer, Index of Subjects, *Min. Mag.* Vols. I.-X. p. 65.

For a recent discussion of pseudomorphs of Calcite after Celestine or Gaylussite, see van Calker, *Zeits. f. Kryst.* (1897) 28, p. 560.

The Identity of Andorite, Sundtite and Webnerite.

By G. T. Prior, M.A., F.G.S., and L. J. Spencer, M.A., F.G.S., Assistants in the Mineral Department of the British Museum.

[Read April 6th and June 17th, 1897.]

I. Historical and Introductory.
II. The British Museum Specimen of Andorite "from Hungary."
III. Krenner's Andorite.
IV. Brögger's "Sundtite."
V. Stelzner's "Webnerite."
VI. Other Specimens of Andorite from Oruro; Occurrence of Alunite.
VII. The Systematic Position and the Characters of Andorite.

I. Historical and Introductory.

ON November 14th, 1892, Prof. J. A. Krenner[1] read before the Hungarian Academy of Sciences an account of a new silver ore from Felsőbánya, to which he gave the name of Andorite. It was described as orthorhombic with $a : b : c = 0{\cdot}97756 : 1 : 0{\cdot}86995$, and as having the chemical composition $2PbS.Ag_2S.3Sb_2S_3$.

At a meeting of the Scientific Society of Christiania, held on December 9th of the same year, Prof. W. C. Brögger[2] gave a description, under the name of Sundtite, of a mineral from Oruro, Bolivia. An analysis by G. Thesen gave to it the formula $(Ag_2,Cu_2,Fe)S.Sb_2S_3$, while crystallographic measurements showed it to be orthorhombic with

$$a : b : c = 0{\cdot}677107 : 1 : 0{\cdot}445786.$$

The angular measurements agree completely with those of Krenner for Andorite; but, not being aware of this, Brögger chose different para-

[1] "Andorit, uj hazai ezüstérez." *Mathematikai és természettudományi Értesitő*, XI. 119-122, 1892. German abstracts of this paper ("Andorit, ein neues ungarisches Silbererz") are given by A. Schmidt in *Zeits. Kryst. Min.* XXIII. 497-499, 1894, and in *Földtani Közlöny*, XXV. 258-259, 1895.

[2] "Sundtit, et nyt mineral fra Oruro i Bolivia." *Forhandlinger i Videnskabs-Selskabet i Christiania*, for 1892, No. 18, 1893; and *Zeits. Kryst. Min.* XXI. 193-199, 1893.

meters. The exact locality in Oruro of Brögger's Sundtite has been given by Dr. R. Pöhlmann[1] of Santiago as the Itos mine.

In 1894 the late Prof. A. W. Stelzner,[2] of Freiberg in Saxony, gave the results of an examination which had been made in 1889 of a mineral from the same mine at Oruro. An analysis by Dr. P. J. Mann gave to this mineral the formula $2\frac{1}{2}(PbS.Sb_2S_3)+Ag_2S.Sb_2S_3$, and accordingly it was described as an argentiferous zinckenite, for which the variety name of Webnerite was proposed. The crystals at Stelzner's disposal were not suitable for crystallographic determination, and the publication of his results was therefore deferred in the hope of better material being obtained. It was only when struck by the similarity in some of the characters of "Sundtite," as described by Pöhlmann, and the mineral he himself had examined, that he was induced to publish his paper, and in it to throw out the suggestion that some of the "Sundtite" described by Pöhlmann might possibly be "Webnerite."

Krenner's paper on Andorite appears to have escaped the notice of Stelzner, otherwise he would have observed that "Webnerite" has essentially the same chemical composition as Andorite.

In the present paper it will be shown:

1. That Andorite, Sundtite and Webnerite, which have been independently described as distinct mineral species, are in fact identical.

2. That Krenner's determination is the correct one for the species.

3. That "Sundtite" was correctly described crystallographically, but wrongly chemically.

4. That "Webnerite," in being called an argentiferous zinckenite, was incorrectly placed crystallographically, though accurately determined chemically.

In such a case it is clear that the slightly older name Andorite is the only one that can be retained for the species.

The identity in the first place of "Sundtite" and "Webnerite" was suggested to us by the examination of a specimen "from Hungary" in the British Museum collection, which, on examination, was found to have the chemical composition of "Webnerite," but the crystallographic characters of "Sundtite." A re-examination, therefore, of the original material described by Brögger and Stelzner appeared to be necessary, and through the kindness of Prof. Brögger on the one hand, and Prof.

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[1] "Notizen über Sundtit von Oruro in Bolivia." *Zeits. Kryst. Min.* XXIV. 124-125, 1894.

[2] "Bemerkungen über Zinckenite von Oruro in Bolivia." *Zeits. Kryst. Min.* XXIV. 125-127, 1894.

Weisbach on the other, this was rendered possible. The result of our examination of these specimens was to show that both were identical with the specimen "from Hungary." It was not until we had completed this work that we happened to notice Krenner's paper, and saw that the mineral "from Hungary" was a specimen of Andorite, and that consequently Andorite, "Sundtite" and "Webnerite" were identical.

II. The British Museum Specimen of Andorite "from Hungary."

The small specimen on which the mineral was found consists of a fragment of argillaceous rock, veined with quartz and pyrites, and containing a few minute cubes of the latter mineral. On one side is a bed of white quartz with a crystallised surface, and on this are distributed a few small crystals of Andorite. Some of these crystals rest only on the apices of the quartz crystals with scarcely any point of attachment, in which case they are completely and symmetrically developed on all sides, while others are more firmly attached and intergrown in the matrix. On the free surface of the specimen the following crystallised minerals were also found, but only in very small amount. Fluorite in minute colourless cubes with small $m\{311\}$ occurs in small groups with yellowish siderite. In one or two cavities are a few delicate hairs having the appearance of the plumosite variety of jamesonite. The fluorite contains a few black acicular enclosures, possibly of the same mineral. Mispickel is represented by one or two very minute prismatic crystals. A few specks of copper pyrites were found, in one case enclosed in Andorite. Lastly, a few minute hexagonal plates may possibly be referred to stephanite. All these minerals are of later formation than the Andorite, which is itself later than the quartz.

All the information we possess as to the locality of the specimen is that it was entered in the Museum register in 1861 as from Hungary; but this locality may possibly have been ascribed to it only because it was then thought to be freieslebenite.

The Andorite crystals are 1—3 mm. in length, have a dull black, often drusy surface, and are much striated and rounded, but are always symmetrically developed. All the crystals have the same short prismatic habit (fig. 1, p. 294), which closely resembles that of freieslebenite. Only rarely is seen a bright surface with a steel-grey colour and metallic lustre. The fracture is smooth and conchoidal, with a curious strong metallic lustre (rather like that sometimes shown by crystals of tetra-

hedrite and bournonite), and an iron-black or dark steel grey colour. There is no cleavage. The mineral is opaque, brittle, and easily crushed to powder. The streak is black and shining, but the fine powder is dull. The hardness is a little over 3, as the mineral scratches calcite with difficulty, and is itself easily abraded when rubbed on fluorite.

The density (weight of 1 cc.) is 5·33, at 19° C. as determined on 0·2152 gram of the material collected for analysis.

Crystallographic Characters (L.J.S.). — Orthorhombic,[1] with the forms :—

$a\{100\}$, $b\{010\}$, $n\{210\}$, $i\{\bar{4}30\}$, $m\{110\}$,
$l\{230\}$, $k\{120\}$, $y\{031\}$, $t\{091\}$.

Brögger's parameters and letters are here used. The following results were obtained from the measurement of 17 crystals and fragments with the δ eye-piece of the Fuess goniometer.

	Limits of measured angles.	No. of edges.	Mean.	Calculated (Brögger).	Measured (Krenner).
$ba = 010 : 100$	88° — 92°	17	90° 6′	90° 0′	90°0′
$bn = 010 : 210$	69½° — 74°	36	72° 2½′	71°18′	—
$bi = 010 : 430$	61° — 67°	6	63°53′	63° 5′	—
$bm = 010 : 110$	55°13′ — 59°11′	35	56°13′	55°54′	55°32′
$bl = 010 : 230$	42¾° — 46°54′	37	45° 0½′	44°33′	44°21′
$bk = 010 : 120$	34°54′ — 37°58′	12	36° 8½′	36°27′	36°28′
$by = 010 : 031$	35° — 41°	29	37°58½′	36°47½′	36°58′
$yy' = 031 : 03\bar{1}$	75°26′ — 77°	9	75°59′	73°35′	—
$bt = 010 : 091$	13°16′ — 15°26′	4	14° 8′	14° 0′	—
$ya = 031 : 100$	90° about	3	90° 0′	90° 0′	—
$yn = 031 : 210$	75° — 76°	8	75°30′	75° 7′	—
$ym = 031 : 110$	62½° — 64°40′	5	63°23′	63°19′	—
$yl = 031 : 230$	55° — 56¼°	4	55°30′	55°12′	—
$yk = 031 : 120$	49½° — 49°33′	2	49°31′	49°58½′	—

The faces of the crystals are so rough that only approximate measurements could be obtained. The macropinacoid and prisms are rounded and very deeply striated parallel to the vertical axis, so that between k (120) and $k(1\bar{2}0)$ there is a continuous band of images, with brighter portions at the positions of $a\,n\,i\,m\,l\,k$; between k and b there are no images.

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[1] Before the idea of the identity of the mineral with Sundtite and Andorite had been entertained, the axial ratios were deduced from the angles $bn = 72°2\frac{1}{2}'$ and $by = 37°58\frac{1}{4}'$, as $a : b : c = 0{\cdot}324 : 1 : 1{\cdot}281$.

The faces of the form $y\{031\}$ are very rough, having a pitted and drusy surface, so that generally only maximum light readings could be obtained. The faces of the form $b\{010\}$ are often brighter, but are striated and rounded horizontally; they are sometimes represented by two or more distinct planes forming a very obtuse salient or re-entrant angle, and several images were seen at 3° to 9° from the true position of b in the zone [100]; this could not be made to agree with any twinning on the assumption that the crystals were monosymmetric.

The habit of the crystals, which is remarkably constant and symmetrical, is shown in fig. 1 (p. 294). In the figure the prisms have been drawn as distinct faces, but on the actual crystals this is only sometimes the case, and then only with k and l. Not infrequently two crystals are intergrown, but no twin law could be discovered.

Chemical Composition (G. T. P.).—As the total amount of material on the single specimen was very limited, only 0·2073 gram was available for analysis. This consisted for the most part of measured crystals, from which the drusy material on the y (031) faces was scraped off as far as possible.[1] The mineral is easily fusible, and is decomposed by hydrochloric acid.

In the quantitative analysis, the finely powdered mineral, dried at 100° C., was weighed into a porcelain boat, and decomposed in a current of chlorine. Only a gentle heat, with a spirit lamp alone, was applied, so that no volatilisation of lead chloride or ferric chloride occurred. After the decomposition in chlorine, the non-volatile chlorides were transferred to a porcelain dish and digested with boiling water, to which a little nitric acid was added. The silver chloride was filtered off, and the filtrate was evaporated down with sulphuric acid; alcohol was then added, and the lead weighed as lead sulphate. In the filtrate the copper was precipitated by sulphuretted hydrogen, and then the iron, after oxidising with bromine water, with ammonia.

The volatile chlorides were absorbed by water containing hydrochloric and tartaric acids. The solution was transferred to a beaker and warmed gently for some time to expel the chlorine. The sulphur was then precipitated as barium sulphate. The filtrate was evaporated down to expel excess of acid and the slight precipitate obtained on dilution added to the rest of the barium sulphate, which was afterwards purified by digestion in hydrochloric acid in the usual manner. In the filtrate the excess of

[1] This drusy material sometimes showed hexagonal outlines under the microscope, and it is possibly the same mineral as that referred to stephanite above.

barium was removed by means of sulphuric acid. The antimony was then precipitated by sulphuretted hydrogen, and, after washing with alcohol and carbon bisulphide and heating to 260°-270° in a current of carbon dioxide, was weighed as trisulphide. The filtrate from the sulphide of antimony contained scarcely a trace of iron.

The mineral was tested for arsenic by the Fresenius-Babo method, but with negative result.

The results of this analysis, given in Column I below, agree with the formula $2PbS.Ag_2S.3Sb_2S_3$ (see IX p. 298).

		I.	II.		III.
Pb	...	21·81	0·923		22·07
Ag	...	11·73	0·943	1·042	11·31
Cu	...	0·73	0·099		0·69
Fe	...	1·45	0·022		0·70
Sb	...	41·76	3·002		41·91
S	...	22·19	6·000		23·32
Insoluble	...	—			0·04
		99·67			100·04

I. The present analysis of Andorite "from Hungary," made on 0·2073 gram.

II. The atomic ratios of the same with S=6.

III. J. Loczka's analysis of Krenner's Andorite from Felsőbánya, Hungary. The 0·70 per cent. of iron includes some zinc and manganese.

The close agreement in the measured angles and in the chemical composition shows the identity of our mineral with Krenner's Andorite.

The above description was written before we had read Krenner's paper. We have preferred to leave it in its original form, since the locality of our specimen is somewhat doubtful, and the associated minerals are not the same as those on Krenner's material.

III. Krenner's Andorite.

Krenner's description of the characters of Andorite is in close agreement with the preceding description of the British Museum specimen.

The only important difference is the good cleavage parallel to $b(010)$[1]

[1] $=a(100)$ of Krenner.

noted by him. We have not seen the material described by Krenner, but no cleavage is shown by any of the Andorite ("Sundtite" and "Webnerite") specimens which we have examined. It may, however, be mentioned that while measuring our crystals, indistinct images were sometimes obtained from small points or irregular fractures in approximately the positions of $c(001)$ and $b(010)$, which may indicate the existence of imperfect cleavages in these directions. Krenner gives the fracture as uneven, and does not mention the characteristic conchoidal fracture. The specific gravity in the original paper is stated to be 5·541, but in the abstracts by Schmidt it is given as 5·341, which is very close to the value obtained by us. The analysis published by Krenner is quoted in Column III above.

With Brögger's position of the crystals and parametral plane, Krenner's[1] measured angles $bl = 44°21'0''$ and $bx = 66°0'46''$ give the axial ratios $a : b : c = 0{\cdot}68197 : 1 : 0{\cdot}44496$, and his forms will then be—

$$a\{100\},\ b\{010\},\ m\{110\},\ l\{230\},\ k\{120\},\ u\{130\}$$
$$\{x011\},\ \gamma\{021\},\ y\{031\},\ q\{221\},\ r\{121\},\ \beta\{131\}.$$

Of these forms, $u\{130\}$ [$=n\{210\}$ of Krenner] is not elsewhere recorded.

Brögger's parameters and letters for the forms are the ones here adopted, since his measurements are the more accurate.

IV. Brögger's "Sundtite."

In presenting to the Museum, and thus with great liberality placing at our disposal, about half of the original crystallised material, Prof. Brögger states that Thesen's analysis was not made on the actual material which was measured, and that it is therefore possible that the crystals have not the composition assigned to them by that analysis.

The four small fragments which we have examined consist of an aggregate of bright, well-developed crystals of Andorite and pyrites, the latter being mostly of earlier formation. Scattered over both of these, and partly embedded in them, are small crystals of pyrites; and later still are minute globules of a yellow incrusting mineral, which sometimes completely coats the surfaces of the crystals.[2] There are also a few small aggregates of an

[1] Krenner interchanges $a\{100\}$ and $b\{010\}$; his parametral plane would be (463), which is not an observed form.

[2] The amount of this was too small to make a satisfactory determination of the chemical composition possible. Pöhlmann mentions antimony oxide as a yellow powder dusted over the crystals.

orange-red coloured mineral, and a few black needles with a metallic lustre; similar needles are called stibnite by Brögger, jamesonite by Pöhlmann, and zinckenite by Stelzner, whose determination is based on an analysis. The larger and earlier crystals of pyrites are octahedral in habit, with small cube, $a\{100\}$, and pyritohedral, $\pi e\{210\}$, planes, and are of interest as apparently showing, in addition to the direct form, $é\{210\}$, the inverse form, $e\{120\}$, together with what is apparently the rhombic dodecahedron, $d\{110\}$; but when the crystals are placed on the goniometer, these are seen to be due to frequent oscillations between $a(100)$ and $é(210)$. The smaller crystals of pyrites have a rather different habit, being cubes or cubo-octahedra with small $\pi e\{210\}$.

The Andorite crystals are, as described by Brögger, very bright and rich in faces. The habit is somewhat varied; some of the crystals are thick-tabular parallel to the orthopinacoid $a(100)$, as in Brögger's figure, others are of the same habit as the Hungarian crystals (fig. 1, p. 294), and some have the pyramids in the zone [110, 001] largely developed, as shown in fig. 2. The basal plane is comparatively rare, and, when present, is usually quite small, so that the habit shown in fig. 2 is rather exceptional. The mineral has a steel-grey colour with bright metallic lustre; the powder is black and dull. It is very brittle, and has a smooth conchoidal fracture; it scratches calcite with difficulty. The density (weight of 1 cc.), determined on 0·4778 gram of the material used for analysis, was found to be 5·377 at 20° C.

The following crystallographic determinations were made on the material which was collected for the analysis; most of the fragments which showed crystal faces being measured in order to make certain of the identification of the mineral. The best crystals were not measured, but left intact on the specimens to represent the mineral in the collection; it is therefore probable, as pointed out by Brögger, who measured two crystals, that future measurements will add considerably to the list of forms. On the 15 crystals and fragments so measured the following 37 forms were detected:—

Pinacoids.	Prisms.	Macrodomes.	Brachydomes.	Pyramids.	
a 100	ϕ 610	h 102	x 011	v 112	δ 364
b 010	ψ 510	θ 305	ν 043	χ 223	r 121
c 001	n 210	σ 203	π 032	p 111	ε 362
	o 320	κ 405	γ 021	z 332	ω 132
	m 110	f 101	y 031	q 221	β 131
	l 230	e 302		ρ 331	a 162
	k 120	λ 301			ζ 2.21.7
		μ 902			s 211

Brögger's $g\{250\}$ and $d\{601\}$, and the Hungarian forms $i\{430\}$, $u\{130\}$ and $l\{091\}$ were not observed on these crystals. With these the total number of forms which have been observed on Andorite is 42.

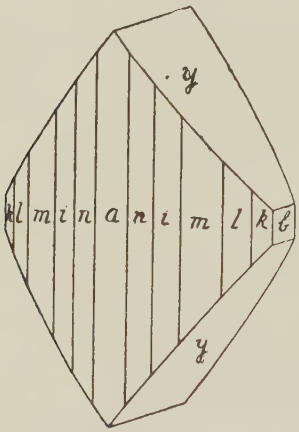

Fig. 1.

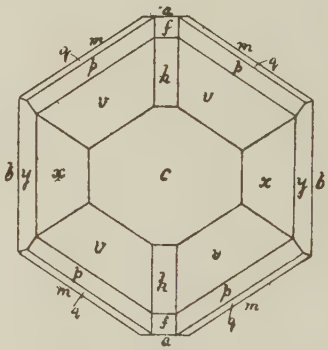

Fig. 2.

The individual crystals showed the following forms :—

1. abc, $nmlk$, hf, $x\gamma y$, $vq\rho$, $r\omega\beta a$. A rough, unsymmetrical crystal; the basal plane is a mere point.

2. bc, $h\theta\sigma f$, $x\pi\gamma y$, $v\chi pq$, $\delta r\varepsilon\omega\beta\zeta$. This crystal is represented in fig. 2; it is only a fragment off the top of a small crystal.

3. ab, $nmlk$, $x\pi\gamma y$, and small pyramidal planes: habit as in fig. 1.

4. a, nml, fe, $x\gamma y$, $v\chi pq$, rs. An unsymmetrical crystal with a large r plane.

5. ab, nml, $x\nu\pi y$, and pyramids.

6. ab, nml, $x\pi y$, pzq.

7. ab, nml, $h\sigma\kappa fe\lambda\mu$, xy, vpq, $\delta r\omega\beta s$. Like fig. 2 without the basal plane.

8. ab, ψnom, $h\sigma fe\lambda\mu$, and pyramids.

9. c, m, he, y, $vpq\rho$, ωs, &c. Like fig. 2, but with the basal plane very small.

10. ab, ϕnm, y, and pyramids.

11 and 12. ab, $nmlk$, and brachydomes. Fig. 1.

13. ab, nml. 14. a, nm. 15. a, n.

The measured angles establishing the new forms are:—

	Calculated (Brögger).	Measured (L. J. Spencer).
$a : \phi(610)$	6° 26′	6°51′. A narrow plane on crystal No. 10.
$a : \psi(510)$	7 43	7°35′. Narrow plane on No. 8.
$a : o(320)$	24 17½	23°, 24°. Striæ on No. 8.
$a : \theta(305)$	68 27	[21°26′], [22°]. Very small on No. 2.
$a : \sigma(203)$	66 18	66°42′, 67°, [23°]. Narrow plane and striæ on Nos. 2, 7 and 8.
$a : \kappa(405)$	62 13½	61°59′. Narrow plane on No. 7.
$a : \lambda(301)$	26 51	27°10′, 26°54′, 27°. Narrow planes on Nos. 7 and 8.
$a : \mu(902)$	18 29	18°35′, 18½°. Narrow plane and striæ on Nos. 7 and 8.
$b : \nu(043)$	59 16½	59°30′. Striæ on No. 5.
$b : \pi(032)$	56 14	56°14′, 57°, [33°19′], [33½°]. Striæ on Nos. 2, 3, 5 and 6.
$c : \chi(223)$	27 55½	27°45′. Narrow planes on Nos. 2 and 4.
$m : \rho(331)$	22 45	22°52′, 22½°. Narrow planes and spots on Nos. 1 and 9.
$c : \delta(364)$	39 44	39°26′, 40°. $\pi\delta = 22°17′$, 22¼° (calculated 22°16′). On Nos. 2 and 7.
$c : \varepsilon(362)$	58 58	59°5′. $y_\varepsilon = 30°37′$ (calculated 30°31′). On No. 2.
$h : a(162)$	51 47½	51°49′. On No. 1.
$y : \zeta(2.21.7)$	6 26	6°23′. A narrow plane between $\beta(131)$ and $y(031)$. On No. 2.

In the above list, the angles are enclosed in square brackets when the measured angle is the complement of the given calculated angle. The new pyramids $\delta\varepsilon a\zeta$ are represented by very small, bright, unstriated planes, giving sharp images, and several good measurements were obtained besides those given above; they lie in several zones on the crystals, e.g. [120, 001], [100, 032], [100, 031], [010, 102] etc., as is shown on the stereographic projection, fig. 3.[1]

[1] On this projection all the forms of Andorite, with the exception of $u\{130\}$, are represented.

Most of the forms noted by Brögger are present as well-developed planes, giving measured angles closely agreeing with the calculated values. Some of the best measurements obtained are—

	Calculated (Brögger).	Measured (Brögger).	Calculated (Krenner).	Measured (L. J. Spencer).
$v\,v' = 112 : 1\bar{1}2$	*23°54½′	*23°54½′	23°53′	23°56′, 23°59½′, 24°3′
$v\,v'' = 112 : \bar{1}\bar{1}2$	43 32	—	43 6	43 25
$h\,h' = 102 : \bar{1}02$	36 26½	36 28	36 8	36 33
$x\,x' = 011 : 0\bar{1}1$	48 3	48 1½	47 58½	48 1, 47°58′

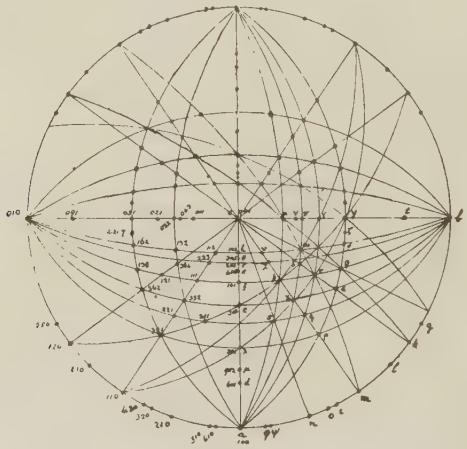

Fig. 3.

With the exception of Nos. 2 and 9, all the above crystals were used for the analysis, and in the collection of more material the characteristic bright conchoidal fracture of the mineral was relied upon. As far as could be seen the only impurities present in the material collected were minute crystals of iron pyrites, which were scattered like dust throughout the Andorite crystals, and so small that they were only visible under the microscope or with a high-power lens; two or three sharp bright cubo-octahedra of pyrites were large enough to be picked out. That this impurity could have been only small in amount is seen by the low per centage of iron shown in the analysis. The methods adopted in the analysis were the same as those described on p. 290. The results given in Column IV below agree closely with the formula $2PbS.Ag_2S.3Sb_2S_3$; thus proving the identity of "Sundtite" with the Hungarian mineral.

		IV.	V.		VI.
Pb	...	24·10	1·013		trace
Ag	...	10·94	0·879	0·975	11·81
Cu	...	0·68	0·096		1·49
Fe	...	0·30	0·043		6·58
Sb	...	41·31	2·990		45·03
S	...	22·06	6·000		35·89
		99·39			100·80

IV. The present analysis of Brögger's "Sundtite" from Oruro, made on 0·4956 gram (G. T. Prior). No trace of arsenic was detected by the Fresenius-Babo test.

V. The atomic ratios of the same with S = 6.

VI. G. Thesen's analysis, which was given by Brögger as representing the composition of "Sundtite." In the original paper no details are given as to the methods of analysis or of the material used; but, as stated above, Prof. Brögger has informed us that the analysis was not made on measured crystals, and that the material handed over for chemical investigation was all used up in the analysis. The specific gravity of 5·50 was determined on this material. Under these circumstances it is useless to criticise the results, but it may be suggested that the iron was present as pyrites.

V. Stelzner's "Webnerite."

The specimen kindly presented to the British Museum by Prof. A. Weisbach consists of one of the indistinct crystals from Stelzner's original specimen in the collection of the Berg-Akademie at Freiberg. The smooth conchoidal fracture with strong metallic lustre, and the other characters which could be directly observed are in agreement with those of the Hungarian mineral. The striated zone of prisms gave a continuous band of images with brighter parts corresponding to the positions of $a(100)$, $n(210)$ and $i(430)$, as is shown by the following rough measurements:—

	Calculated.	Measured (L. J. S.).
$an = 100 : 210$	18°42′	$16\frac{1}{2}°$, 17°, 18°
$ai = 100 : 430$	26°55′	27°, 27°, $27\frac{1}{4}°$

Rough faces of the form $y\{031\}$ also seem to be present.

These crystallographic measurements, when considered in connection

with the chemical composition as quoted in Column VII below, are enough to show that "Webnerite" is identical with Brögger's "Sundtite" from the same locality, and with Andorite.

Stelzner gave to "Webnerite" the formula $2\frac{1}{2}(PbS.Sb_2S_3)+Ag_2S.Sb_2S_3$. But, as shown below, when the copper is taken as replacing silver, and when the iron is considered to be present as pyrites, the numbers obtained in the analysis agree just as closely with the simpler formula $2(PbS.Sb_2S_3)+Ag_2S.Sb_2S_3$.

		VII.	VIII.		IX.	X.
Pb	...	24·30	1·004		23·81	25·53
Ag	...	10·25	0·812	0·900	12·42	10·65
Cu	...	0·65	0·088		—	—
Fe	...	0·53	—		—	—
Sb	...	40·86	2·896		41·63	41·66
S		23·10	6·000		22·14	22·16
		99·69			100·00	100·00

VII. P. J. Mann's analysis of Stelzner's "Webnerite" from Itos mine, Oruro, Bolivia.

VIII. The atomic ratios of the same with S = 6, after deducting iron and the corresponding amount of sulphur, as pyrites, FeS_2.

IX. The calculated percentage composition of $2PbS.Ag_2S.3Sb_2S_3$.

X. The calculated percentage composition of $2\frac{1}{2}(PbS.Sb_2S_3)+Ag_2S.Sb_2S_3$.

VI. Other Specimens of Andorite from Oruro; Occurrence of Alunite.

In the British Museum are two other specimens of Andorite from Oruro, which may be described here. One of these is labelled "Sundtit, Mina Itos, Oruro," by T. Hohmann of Valparaiso, by whom it was sent to Europe, his authority for the locality being Pöhlmann's paper. This shows rather indistinct crystals of Andorite, of the habit represented in fig. 1, with cubo-octahedra of pyrites, on a matrix of decomposing massive pyrites and quartz. Some of the massive Andorite is mixed with pyrites, and does not seem to be very pure. There is a small radiated group of acicular crystals which may be jamesonite, zinckenite, or stibnite.

White crystalline *alunite* occurs, coating parts of this specimen. It consists generally of a loose aggregate of minute crystals, but in places

it is more compact. This occurrence of alunite is very similar to that recently described by E. B. Hurlburt[1] from the National Belle mine, Red Mountain, Ouray Co., Colorado. Under the microscope the material is seen to consist wholly of sharply developed crystals rather more than 0·01 mm. in diameter. Each crystal consists of a rhombohedron truncated by the basal planes as in Hurlburt's figure, but here the basal planes are always triangles and the outlines of the crystals are hexagons. When the crystals rest on a basal plane they are isotropic, but they are too small to give an interference figure in convergent polarised light. The chemical reactions were in agreement with alunite, which is a hydrated basic sulphate of aluminium and potassium. The mineral gave a good potassium flame which was not masked by sodium, as would be the case with the Red Mountain material in which half the potassium is replaced by sodium. Coating some of these crystals, as well as other parts of the specimen, is a cherry-red powder, which, as it contains iron, is probably turgite. It was possibly formed, together with the alunite, by the decomposition of the pyrites.

The second specimen is labelled "Zinckenit,[2] Socavon de la Virgen, Oruro." In a cavity at the back of the specimen is a small amount of Andorite, as shown by qualitative chemical analysis and the measurement of crystal fragments. Besides pyrites and quartz, there are also crystals of kaolin, cassiterite, both massive and in minute crystals of a pale yellowish colour, and a little alunite. No tetrahedrite was seen on this specimen. The prismatic crystals of cassiterite are about $\frac{1}{4}$ mm. in length, and show the forms $m\{110\}$ and $s\{111\}$; the measured angles varied only slightly from the mean value $ms^3 = 46°48'$. The massive cassiterite was tested for germanium, but with negative results. The minute alunite crystals are similar to those described above, but here the basal planes are smaller, so that the crystals have the appearance of cubes; the forms present are therefore $r(100)$ and $c(111)$. The most striking mineral on this specimen is the coarsely acicular "zinckenite;" with it is a more finely acicular mineral with the felted appearance of "feather ore."

This occurrence of Andorite at the Socavon de la Virgen (= Virgin level) shows that the Itos mine is not the only mine at Oruro in which the mineral is found. It is therefore not absolutely certain that Brögger's specimen came from the Itos mine, as stated by Pöhlmann.

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[1] *Amer. Journ. Sci.* 1894, XLVIII. p. 130.

[2] This may possibly be jamesonite.

[3] Dana gives $ms = 46°26\frac{2}{3}'$, and Miller 46°26'.

The silver mines of Oruro have been described by H. Reck,[1] A. Webner,[2] formerly of the Itos mine, Weiner,[3] and A. W. Stelzner.[4] They form a group of mines in the hill on the west side of the town of Oruro, which is the capital of the department Oruro. It would seem that Andorite is one of the principal silver ores of these lodes, which are some of the most important in South America, and were worked by the Indians previous to their discovery by the Spaniards in the sixteenth century.

VII. The Systematic Position and the Characters of Andorite.

The formula of Andorite ($2PbS.Ag_2S.3Sb_2S_3$) resembles that of zinckenite ($PbS.Sb_2S_3$) in representing a metasulph-antimonite, and as both zinckenite and Andorite are orthorhombic, it might be expected that there would be some crystallographic relationship between them. The only angles, however, which can be compared are not at all close. In the elongated and striated zones there is an approach to angles of 60°, but this is shown by Penfield[5] to be the case with many sulpho-salts.

Sundtite.		Zinckenite.	
$am = 100 : 110$	34° 6′	$c\varepsilon = 001 : 102$	29°40½′
$ch = 001 : 102$	18°13¼′	$bk = 010 : 061$	14°42′

As there is also no crystallographic relation between Andorite and the monosymmetric miargyrite ($Ag_2S.Sb_2S_3$), it may be concluded that in Andorite the lead and silver do not isomorphously replace each other, but that we have here a definite double salt with the composition $2(PbS.Sb_2S_3) + Ag_2S.Sb_2S_3$. The cubic brongniartite ($Ag_2S.PbS.Sb_2S_3$) also seems to be a double salt which is related in a similar manner to the orthorhombic jamesonite ($2PbS.Sb_2S_3$), though there is here nothing to correspond to miargyrite. Amongst well-determined minerals, other double salts are freieslebenite and diaphorite, bournonite and aikinite: and in the whole range of the sulpho-salts, with the exception of tetrahedrite-tennantite and polybasite-pearceite, isomorphous replacement seems to

[1] *Petermann's Geograph. Mitth.* 1867, p. 319.

[2] *Berg- und Hüttenm. Zeit.* 1887, p. 157; 1888, pp. 241 and 263.

[3] *Annales des Mines* 1894, Ser. 9, V. Mem. p. 511, with map.

[4] *Zeits. deutsch. geol. Ges.* 1897, XLIX. pp. 82, 126. See also F. de Castelnau, *Expédition Amerique du Sud*, 1851, III. 358.

[5] *Amer. Journ. Sci.* 1896, [4] II. p. 28; and *Zeits. Kryst. Min.* 1896, XXVII. p. 76.

take place only to a limited extent, and when two bases occur together in larger quantity double salts are formed.

Summary of the Characters of Andorite.

Orthorhombic.—$a : b : c = 0{\cdot}6771 : 1 : 0{\cdot}4458$.

$100 : 110 = 34°6'$, $001 : 101 = 33°21\frac{1}{2}'$, $001 : 011 = 24°1\frac{1}{2}'$.

A list of forms is given on pp. 293-4.

Colour, dark steel-grey ; brilliant metallic lustre ; opaque.

Streak, black and shining ; powder dull.

No cleavage ; fracture smooth and conchoidal. Brittle.

Specific gravity 5·35. Hardness $3\frac{1}{4}$.

Composition, $2PbS.Ag_2S.3Sb_2S_3 = PbAgSb_3S_6$.

Localities : Felsőbanya, Hungary ; the silver-tin mines at Oruro, Dept. Oruro, Bolivia.

On Tripuhyite, a new Antimonate of Iron, from Tripuhy, Brazil.

By Dr. E. Hussak, of the Geological Survey of S. Paulo; and

G. T. Prior, M.A., F.G.S., Assistant in the Mineral Department of the British Museum.

[Read June 17th, 1897.]

THIS new antimonate was found in the cinnabar-bearing gravel of Tripuhy, Minas Geraes, Brazil. The minerals associated with it in the gravel, including the two new titano-antimonates lewisite and derbylite, have already been described in this Magazine (Vol. XI. No. 50, p. 80, and No. 52, p. 176). The original source of the lewisite and derbylite has been proved to be the muscovite-schists accompanying itabirite in the neighbourhood of Tripuhy. From these schists, doubtless, is also derived the tripuhyite, although as yet this new mineral has only been found in fragments loose in the gravel, and not intergrown with fragments of the muscovite-schists as is often the case with both lewisite and derbylite.

Physical Characters.

The mineral does not occur in the gravel in crystals, but only in microcrystalline aggregates of a dull greenish-yellow colour. Examined in thin sections under the microscope, these are seen to consist of translucent, highly refractive and strongly doubly-refracting grains. Observation in convergent light, with the help of a Czapski eye-piece, showed that the mineral was biaxial, but the individual grains were too small to allow of more exact determinations. Under a $\frac{1}{12}$th immersion objective, a lightly crushed fragment was seen to consist almost wholly of crystalline doubly-refracting, non-pleochroic, material of a bright canary-yellow colour, which appeared to be fairly homogeneous, as the only impurity observed consisted of a few minute flakes of a colourless doubly-refracting mineral, most probably muscovite. The streak is canary-yellow.

The specific gravity (weight of 1 cc.) was 5·82 at 19° C., as determined on 0·3035 gram.

Chemical Characters (G. T. P.).

The mineral gave off no water when heated in the closed tube. In the Bunsen flame it was infusible, but blackened and gave off fumes colouring the flame pale greyish blue (Sb), and left finally a residue consisting mainly of red ferric oxide. It was insoluble in hydrochloric and nitric acids. Qualitative examination showed the presence of antimony and iron, with only traces of titanium and calcium.

For the quantitative analysis only 0·2475 gram was available. The mineral was decomposed by heating in hydrogen, and the analysis conducted as in the case of lewisite and derbylite (*loc. cit.*).

The numbers obtained were as follows:—

		Molecular ratios.
Sb_2O_5	= 66·68	·208
FeO	= 27·70	·385
CaO	= 0·82	·014
SiO_2	= 1·35	·023
Al_2O_3	= 1·40	·014
TiO_2	= 0·86	·010
Undet. (Alkalies ?)	= (1·19)	
	100·00	

The amount of material available for chemical investigation was not sufficient to allow of experiments to determine the state of oxidation of the iron. If the iron be considered, as above, to be in the ferrous state, the numbers obtained in the analysis agree approximately with the formula $2FeO.Sb_2O_5$.

Monazite and Xenotime in European Rocks.

By Orville A. Derby, F.G.S., of the Geological Survey of S. Paulo, Brazil.

(Communicated by the General Secretary.)

[Read June 17th, 1897.]

As the phosphates of the cerium and yttrium groups, monazite and xenotime, have proved to be quite widespread microscopic accessories in certain types of Brazilian granites and gneisses, a *batea* test has recently been made on a number of hand specimens obtained from the mineral establishment of Dr. F. Krantz, of Bonn, for the purpose of determining if these interesting minerals were equally characteristic of the corresponding types of European rocks. About half of an ordinary museum specimen was crushed in a porcelain mortar to pass through a moderately fine sieve, concentrated in the batea and examined under the microscope after cleaning with the Thoulet or Klein solution, or both, and, when necessary, with the electro-magnet. The identifications of the minerals in the residues thus obtained, especially in cases of doubt, have been kindly revised by Dr. Eugen Hussak.

In making the selection for examination, attention was mainly directed to kaolins of granitic origin, pegmatites, muscovite and muscovite-biotite granites and gneisses, experience in Brazil having shown that negative results might usually be expected from rocks of a more basic character, though one of the minerals in question, monazite, has proved to be a quite common accessory in the purely biotite granites and gneisses as well. In a number of cases the residue obtained was so small (the almost ubiquitous zircon, magnetite and ilmenite being represented by less than a dozen grains) that no definite conclusion could be drawn from a negative result with regard to the presumably rarer accessories. In the notes below, other accessories are only mentioned in cases in which they seemed to offer special interest.

Kaolins.

Limoges, France.—Residue very small, containing a few minute milky-white octahedra of xenotime, transparent and glassy at the edges, associated

with rare elongated and short stout prisms of zircon. More abundant are irregular amorphous pinkish granules which, as they often enclose crystals of xenotime and give micro-chemical reactions for phosphoric acid, and apparently also for yttria, are presumed to be alteration products of that mineral. The other elements of the residue are tourmaline in minute slender, white, blue and brown needles, magnetite in minute splendent octahedra and aggregates, ilmenite showing a yellowish alteration product, anatase in irregular bluish white grains, and pseudobrookite represented by a single transparent tabular crystal of deep red colour.

Carlsbad, Bohemia.—Rare grains of unmistakable monazite and anatase, mingled with abundant splendent prisms of zircon and rare octahedral crystals which, from the form and optical characters, so far as they can be determined, might be either zircon or xenotime. A single rather ill-formed specimen appears to be one of the characteristic intergrowths of the two minerals, and in this case the said octahedra, and a number of discoloured grains that could not be satisfactorily determined, may be presumed to be xenotime. A peculiar feature of this kaolin is a great abundance of siderite in rounded aggregates, evidently of secondary origin, ranging from microscopic grains up to the size of a pea, or larger.

These two kaolins appear to result from the decomposition of pegmatites or of muscovite-granites. Washings were also made of kaolin from Seilitz, near Meissen, Saxony (syenite ?), Schemnitz, Hungary (trachyte ?), and Türkismühle, Nahe, Rhenish Prussia. The residue of the second was comparatively abundant, but relatively small in the other two. Zircon occurs in all in sharp angled splendent prisms, with which rounded forms rich in faces are associated in the Schemnitz rock. The secondary titanium minerals are anatase in the first (possibly after original titanite, as the ilmenite grains show little or no alteration), rutile (sagenite) in the second, and a yellowish aggregate (leucoxene ?) in the third. Dirty white opaque grains in the Schemnitz rock are possibly altered titanite.

Pegmatites.

Hitterö, Norway.—Residue extremely small, with rare grains of zircon and a single grain of titanite.

Ronsperg, Bohemia.—Residue small, mainly composed of garnet with rare tourmalines, zircons and monazite. The specimen, like the preceding, is a typical graphic granite.

Davos, Switzerland.—Residue of garnet with extremely rare zircons.

Offenbanya, Hungary.—Residue consisting mainly of coarse tourmalines and garnets; zircon and iron minerals extremely rare.

Glaser-Haj, Hungary.—Garnet only, no zircon or iron minerals observed.

Chaum, Pyrenees.—Tourmaline only, no zircon observed.

Vallée de Barbe, Pyrenees.—A single grain of zircon only, represents the rare accessories.

Geyer, Saxony.—Residue small, consisting mainly of prismatic zircons with rare octahedral forms that may be either zircon or xenotime, a single fragment of monazite.

Selb, Bohemia.—Residue, apart from tourmaline and epidote, extremely small, consisting mainly of iron minerals and rare grains of zircon and orthite (?).

Pisek, Bohemia.—Residue abundant, but consisting almost exclusively of fragments of the macroscopic monazite and xenotime for which the locality is celebrated, perfect microscopic crystals being extremely rare.

Striegau, Silesia.—Residue consisting of fine white epidote and beautiful microscopic tourmalines, the heavy accessories being rather rare, small, ill-formed and discoloured by iron oxide, so that their determination is somewhat difficult. Zircon and xenotime occur, but no monazite was observed. Anatase and orthite are rare.

Fuchsberg, Striegau, Silesia.—Abundant residue of coarse tourmaline, apatite, and fine green epidote. Zircon abundant in rather large splendent prisms, with which are associated rare octahedral forms which have more the aspect of zircon than of xenotime.

Oberbessenbach, Spessart.—Residue mainly of magnetite and garnet, with a few large zoned white and yellow zircons and numerous fragments that may be of macroscopic yellow zircons or of monazite. Rather large opaque and rudely formed octahedra occur that are probably partially altered xenotimes, a conclusion that is favoured by one or two ill-formed grains that appear to be intergrowths of xenotime and zircon.

Glattbach, Spessart.—A great quantity of garnet (spessartine) of remarkable beauty and perfection of form, numerous and comparatively large intergrowths of xenotime and zircon, with rarer isolated individuals of the same minerals and of monazite.

Aplites.

Grotto Doccei, Elba.—Numerous but minute intergrowths of xenotime and zircon, whitened, but of singular beauty and perfection of form, with rarer isolated grains of the same minerals, monazite and orthite with strong pleochroism suggestive of andalusite.

Stutzerbach, Thuringia.—Zircon rare and ill-formed, but rather large, magnetite in fine octahedra.

Beresovsk, Ural (*Beresite*).—A great quantity of cubic pyrites with rare magnetite, zircon, monazite and titanite, the latter possibly of secondary origin, as it is whitish, and in other respects different in aspect from the original titanites of the other rocks examined.

Muscovite Granites.

Heidelberg, Baden.—Residue mainly composed of tourmaline and handsome garnets like those of the pegmatite of Glattbach. The heavy residue is very small, and composed of small and mainly rounded grains that, being discoloured by oxide of iron, are not easily determinable. Unmistakable grains of zircon and monazite were observed, and xenotime is probably also present, as indicated by rare octahedra. These might be zircons, but are more probably xenotime, as a couple of ill-formed grains that are almost certainly intergrowths of the two minerals were observed.

Eibenstock, Saxony.—Zircon abundant and fine, rutile also abundant and with the aspect of cassiterite, but giving the titanium reaction with the blowpipe; monazite, xenotime and anatase rare. The grains referred to xenotime are dirty and ill-formed, but the occurrence of the mineral is apparently confirmed by a few cases of intergrowth, though these are not so perfect as might be desired for a perfectly satisfactory identification.

Selb, Bavaria.—Zircon abundant, mostly semi-opaque, whitened and pitted (malaconised). The comparatively rare grains referred to xenotime have suffered the same alteration, and are therefore scarcely distinguishable. Apparent intergrowths of the two occur rarely. The rather rare monazite, on the contrary, is unaltered, bright yellow, often coated with oxide of iron.

Asch, Bohemia.—An almost completely decomposed rock, which has perhaps furnished the kaolin from the same locality, as the heavy residue is similar, being composed almost exclusively of zircon and anatase.

Königshain, Silesia.—Fine zircons with a great abundance of beautifully crystallised brown epidote.

Sevcrn, Vosges.—Residue, exclusive of tourmaline, small, consisting of extremely pellucid zircons and greenish anatase.

Berzet, Auvergne, France.—Zircon abundant and fine, mostly rounded, though sharp angled forms also occur; monazite comparatively rare in

rounded grains, rarely with distinct faces; blue anatase abundant, fine in colour, but ill formed.

Porto, Portugal.—Zircon with much yellow and brown anatase, rarely in perfect crystals, rare grains of brookite and of a black mineral with a yellow margin like that of the two-mica granite from the same locality.

Muscovite-Biotite Granites.

Wunsiedel, Bavaria.—Zircon abundant in extremely handsome elongated prisms, often rounded at the edges and irregularly pitted, as if they had suffered an action of re-absorption; the rare octahedral grains have more the aspect of zircon than of xenotime; blue and green anatase, brookite, apatite and andalusite.

Frauenthal, Bohemia.—Residue, consisting mainly of tourmaline and andalusite, with rare zircons and fine crystals of blue and green anatase.

Reuth, near Gefrees, Fichtelgebirge.—Much apatite with zircon, monazite and xenotime. The two last not being well defined in form and colour from zircon, were verified with the spectroscope. Intergrowths of xenotime and zircon occur, but are ill defined, owing to the almost complete envelopment of the central crystal of zircon by the xenotime.

Johanngeorgenstadt, Saxony.—Zircon abundant in large, handsome prisms and small rounded grains; yellow rutile also abundant; monazite comparatively rare.

Corwan, Cornwall.—Zircon abundant in small and handsome prisms, with extremely elongated pyramids; iron-stained and ill formed grains may represent monazite or xenotime, or both, but are perhaps zircons.

Haytor, Devonshire.—Zircon and monazite tolerably abundant in pellucid grains, mostly rounded at the edges and angles.

Louchon, Pyrenees.—Zircon abundant in elongated prisms and rounded forms, rich in faces, rare grains of rutile.

Altweiler, Vosges.—Much zircon and blue anatase; a black mineral of which a single grain shows faces apparently of the tetragonal system, could not be determined.

Bressoir, Vosges.—Apatite abundant with fine blue anatase; zircon and andalusite rare.

Porto, Portugal.—Zircon, anatase and very handsome brookite are comparatively rare; more abundant is an opaque yellowish mineral, which evidently results from the alteration of a black one, as grains with a black centre and a yellow semi-transparent border are frequent. The appearance is that of ilmenite with a superficial alteration to leucoxene, or of

pyrites altered to limonite, but negative results were obtained in tests for titanium, and with acids. The form is apparently tetragonal, as several tolerably well formed prisms and a single perfect octahedron were observed. A test for silica with hydrofluoric acid gave a negative result. The same mineral occurs rarely, and not so well defined in form, in the muscovite granite of the same locality.

Biotite Granites.

As most of the representatives of this group at hand were known to carry titanite, and were therefore presumed to be unfavourable for the special purpose of this investigation, only a few were examined on account of some peculiarity of the type or of interest in the locality.

Jekaterinenburg, Ural (*Plietengranite*).—Great abundance of large and extremely handsome titanite, few and small zircons, green epidote, much magnetite, apatite abundant.

Wiborg, Finland (*Rapakiwi*).—Comparatively large and handsome zircons, with apatite. The larger zircons often contain crystalline inclusions which in part seem to be small needles of the same mineral, in part apatite.

Breitenstock, Switzerland (*Protogine Granite*).—Great abundance of small but very fine zircons, with fragments of tourmaline.

Heidelberg, Baden (*Porphyritic Granite*).—Zircon and apatite abundant, the former frequently enclosing crystals of magnetite.

Serra de Conillas, Portugal.—Zircon and apatite, the latter much the most abundant, large and fine, often with pleochroic bands of dust-like inclusions arranged parallel to the prismatic faces.

Shap, Westmoreland.—Zircon, apatite and titanite abundant and fine, pyrites very rich in faces.

Granite-Gneiss.

Altweiler, Vosges.—Residue small, consisting principally of apatite with rare zircons.

Repistye, Hungary.—Fine zircons with tourmaline and rare grains of anatase.

Streitkopf, Thuringia.—Residue abundant, with apatite and zircon in about equal proportions.

Ruhla, Thuringia.—Handsome sharp angled zircons abundant, with fine crystals of apatite and with titanite.

Trusethal, Thuringia.—Zircon extremely abundant and exceptionally fine, full of cavities, and the larger ones with included crystals which appear to be small zircons.

Albersweiler, Bohemia.—Residue small, with more apatite than zircon.

Fussberg, near Aschaffenburg, Spessart.—Zircon extremely abundant in small and for the most part rounded grains. No other rare accessories observed.

Grauberg, Spessart.—Zircon abundant with beautiful zonal structure, apatite abundant, monazite rather rare but in large grains, rutile (?) rare, no xenotime seen.

Ruhwald, near Gailbach, Spessart.—Much magnetite; non-magnetic residue very dirty and discoloured by oxide of iron, with zircon, monazite, and xenotime in about equal proportions; apatite, which is given by Ritter, extremely rare, only two grains being found in two preparations.

Lochmühle, near Rochlitz, Saxony.—Of the two specimens from this place, one is decidedly gneissic, the other decidedly granitic in aspect. Both are rich in biotite, and from their general appearance were, before washing, judged to be unfavourable for the main purpose of this investigation. Both gave extremely abundant heavy residues, in which small milky-white octahedra of xenotime predominate. The grains are often transparent and glassy at the margins, the troubled milky appearance of the central portions being apparently due to fracturing, rather than to alteration. Monazite in tabular rounded crystals, rich in inclusions, is abundant in the granitic type, but lacking in the other. The same type has rare prisms of apatite with a dark centre, full of dust-like inclusions and larger rounded masses that resemble glass inclusions. Both rocks have an abundance of colourless zircons, rich in inclusions of prismatic and pyramidal types, the latter often compressed giving very singular and beautiful rhombic, rarely trigonal, tabular forms. Rare grains of anatase in both rocks. If xenotime should, like monazite, become commercially valuable, these rocks or the detritus from them might repay examination.

On Blödite from the Punjab Salt Range.

By F. R. Mallet, late Superintendent, Geological Survey of India.

[Read June 17th, 1897.]

THE Salt Range of the Northern Punjab derives its name from the numerous beds of rock salt which are there included amidst the pre-Cambrian strata. Some of these salt beds are of great purity and immense thickness, and have been utilised as a source of the mineral from a remote period, while extensive mines have been opened out by Government since the annexation of the province. The blödite referred to below was discovered in these workings by Dr. H. Warth, lately Deputy Superintendent of the Geological Survey of India, but who, at the time alluded to, held charge of the mines in question.

It appears, from information for which I am indebted to Dr. Warth, that the blödite was first discovered about the year 1875, in the Mayo mines at Khewra, a few miles north of Pind Dádun Khán. It occurred in crystals about half-an-inch long, which, together with colourless and transparent cubic crystals of salt, formed a drusy coating on the sides of a narrow fissure in the rock salt. It was not accompanied by any other mineral of secondary origin; except the salt crystals just mentioned. Although glauberite and selenite have been found under similar circumstances in the same mines, they were not in association with the blödite. About 1887, bigger crystals of the latter, some of which were as much as 3 or 4 inches long and nearly as broad, were discovered in the Varcha mine, which is situated 65 miles W.S.W. from those mentioned above. The mineral from both localities was in very perfect crystals, the majority of them possessing smooth, or even lustrous faces, and sharply-cut edges and angles.

Some of the crystals from the Mayo mines were given by Dr. Warth to Professor Quenstedt, who described their crystallographic character in his *Handbuch der Mineralogie*.[1] The similarity of the crystals to those of the same mineral from Stassfurt is pointed out; but the complication is introduced of choosing axes different from those previously adopted by Brezina, Groth and Hintze, and vom Rath, for the Hallstadt and

[1] 3rd edition (1877), p. 645.

Stassfurt blödite, and of orientating the crystal in a different way. What these writers regard as the front of the crystal, in the normal position, Quenstedt places behind. The symbols for 11 or 12 forms are given, all of which are amongst those previously observed on the Stassfurt mineral.

About the same time the blödite from the Mayo mines was examined in respect to its crystallography by Professor Schimper.[1] Adopting the same axes as Groth[2] and vom Rath[3], Schimper observed 13 forms which are common to the Stassfurt crystals, and which include all those recorded by Quenstedt. He likewise determined two new forms, not hitherto noticed on the Stassfurt blödite; and pointed out the similarity in habit of the mineral from the two localities, as well as the agreement in value of corresponding angles, Schimper's measurements generally differing from Groth and Hintze's by not more than one minute.

Dr. Warth has recently given me the opportunity of examining 11 specimens from Varcha, and I have also received some out of the same mine from Mr. Holland, of the Indian Geological Survey. Besides most of those mentioned by Schimper, I noticed three forms on one or other of the crystals, which are new in respect to the Salt Range mineral, but have been described by the authors quoted as occurring on the Stassfurt blödite; this makes a total of 18 forms as given below.

c	$=(001)=0P$	Common to Stassfurt and Salt Range. W. Schimper.
d	$=(011)=P\infty$	
p	$=(111)=-P$	
m	$=(110)=\infty P$	
n	$=(210)=\infty P2$	
a	$=(100)=\infty P\infty$	
b	$=(010)=\infty P\infty$	
λ	$=(310)=\infty P3$	
ν	$=(120)=\infty P2$	
q	$=(\bar{2}01)=+2P\infty$	
u^4	$=(\bar{1}11)=+P$	
s	$=(\bar{2}11)=+2P2$	
o	$=(121)=-2P2$	

[1] *Zeitsch. f. Kryst. u. Min.*, I. (1877), 70.
[2] *Zeitsch. d. deuts. geol. Gesell.*, XXIII. (1871), 670.
[3] *Pogg. Annalen*, CXLIV. (1872), 586.
[4] y in original.

x	$=(\bar{1}21)=+2\mathrm{P}2$	Common to Stassfurt and Salt Range.
y	$=(\bar{2}21)=+2\mathrm{P}$	
e	$=(021)=2\mathrm{P}\infty$	F. R. Mallet.
μ	$=(130)=\infty\mathrm{P}3$	Salt Range only.
f	$=(\bar{1}44)=+\mathrm{P}4$	W. Schimper.

Of these forms, p, c, d, m, n are predominant (as they are in the Stassfurt crystals also). None of them are absent, or even subordinate, in any fairly perfect crystals that I have examined. o and q are sometimes of fair size, while the rest are generally small and often quite minute. Some are of very rare occurrence; although a and b are mentioned by both Quenstedt and Schimper, I have never noticed the latter, and the former only once. f was also absent on the Varcha crystals, and λ appeared on but one.

The authors quoted observed 21 forms on the Stassfurt crystals, of which five have not been noticed on those from India. But probably this number would be reduced if still further specimens were submitted to examination.

The mineral is colourless, and to a large extent transparent; but there are few crystals in which the limpidity is not here and there imperfect. The examination of sections under the microscope shows that this cloudiness is due to multitudinous cavities, which generally vary in size from 0·1 or 0·2 millimetres downwards. Some are very irregular in outline, but the larger proportion are less markedly so, and often rudely elliptical. Many look more or less like negative crystal cavities, and some with distinct polyhedral boundaries undoubtedly are such. In rare cases one or two of the predominant forms like (001),0P and (111),$-$P can be recognised. With few exceptions the cavities are nearly filled by a colourless liquid, the accompanying bubbles being comparatively minute; but in a small minority no bubble is apparent, or again, there is no liquid. In some exceptionally large cavities, about a millimetre long, the movement of the bubbles can easily be seen when the specimen is turned. A few cavities were noticed containing colourless crystals in the liquid: the outline of the only one with very determinate form was rectangular, and nearly square, suggestive of sodium chloride.

An optical examination of the mineral gave results in fairly close agreement with those obtained by Groth and Hintze in respect to that from Stassfurt.[1] The crystals are negative, with the optic axes in the

[1] *l. c.*

plane of symmetry, the bisectrix $\mathfrak{a}$ nearly bisecting the acute angle between the vertical and clino-diagonal crystallographic axes. With sections parallel to the plane of symmetry, and bounded on one side by the trace of the basal plane, the mean of numerous determinations of the angle $\mathfrak{a} \wedge \dot{c}$ (= angle β – angle between trace of basal plane and $\mathfrak{a}$) was :—

For red light[1]	...	42°9′
For blue light[2]	...	41 5

The values obtained by the authors quoted, using similar light, were 44°48′ and 43°21′.

With sections perpendicular to the bisectrices, the following mean results were obtained :—

		$2H_a$.	$2H_o$.
For red light	...	71°22′	111°51′
For blue light	...	73 26	109 0

The value of $2V_a$ derived from these is 70°18′ for red, and 72°36′ for blue ; Groth and Hintze's angles are 70°5′ and 72°34′. When a section perpendicular to $\mathfrak{a}$ is examined by white light, the inclined dispersion is very clearly displayed in the colouration of the rings and brushes.

The sections employed not having been cut, nor the observations made, with the precision now attainable by means of the instruments devised by Mr. A. E. Tutton, the above results cannot be regarded as more than fairly good approximations. In the one or two cases where my results differ from Groth and Hintze's by only a few minutes, such close agreement is little more than fortuitous.

In some of the earlier accounts the blödite from more than one European locality is described as efflorescent,[3] while two or three writers allude to the substance attracting moisture.[4] The Indian crystals are, however, perfectly stable in the air (of London). Some which I have had in my possession for the last eight years, without protection from the atmosphere, show no sign of alteration ; and further, a sample taken for

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[1] Red glass. [2] Ammoniacal cupric sulphate.

[3] *John* ; *Chemische Schriften*, VI. (1821), 240 (as quoted by Tschermak : I have been unable to refer to the original). *Göbel ; G. Rose, Reise nach dem Ural* (1842), II. 270. *Tschermak : Sitzungsb. d k. Akad. der Wiss. Wien*, LX 1 *Abth.* (1869), 722. Also *v. Foullon ; Jahrb. k. k. geol. Reichanst. Wien*, XXXVIII. (1888), 3. Tschermak, however, found the Hallstadt mineral perfectly stable.

[4] *Hayes ; Proc. Nat. Hist. Soc. Boston*, V. 391. *Groth and Hintze ; l.c. : v. Foullon ; l.c.*

analysis, after being finely powdered and placed in a desiccator with oil of vitriol till the weight remained constant, only lost ·07 per cent., which was, no doubt, partly due to the liquid in the cavities. Another portion, again, exposed in fine powder to the air for a week during weather of medium humidity, only gained ·08 per cent.

The mineral, freed from moisture as mentioned above, yielded on analysis—

		I.	II.	Mean.[1]	Theory.[1]
MgO	...	11·96	11·97	11·97	12·04
Na_2O	...	18·48	18·59	18·53	18·56
SO_3	...	47·75	47·89	47 82	47·86
H_2O	...	21·59	21·50	21·54	21·54
NaCl	...	·07	·07	·07	
		99·85	100·02	99·93	100·00

There was likewise an unweighable trace of material insoluble in water, and the same of lime. The chlorine is doubtless in combination with sodium. As previously mentioned, the blödite was found on rock salt, and crystals of salt are associated with it, and sometimes embedded in it; hence care is necessary in obtaining a sample as free from chlorine as the above. The minute quantity found is probably due, in part at least, to the saline matter dissolved in the liquid of the cavities.

Some of the earlier accounts differ as to the tenacity with which the water in blödite is retained on heating the mineral. According to John the massive blödite of Ischl loses the whole of its water when heated for two hours in a water bath.[2] Tschermak, on treating the Hallstadt mineral in the same way until the weight remained constant, found that three-eighths of the water was expelled, the remainder being given off on ignition; he consequently wrote the formula of the mineral (which he named simonyite) $2MgSO_4 2Na_2SO_4.5H_2O.3aq.$[3] Groth and Hintze, on the other hand, found that Stassfurt blödite loses about 8·8 per cent. at 100° C. and 10·12 per cent. at 150°, the former figures being, as they point out, in excess of three-eighths (8·08 per cent.) of the total water.[4] These

[1] The atomic weights used are those adopted by Prof. F. W. Clarke in his *Recalculation of the Atomic Weights*. New Edition, 1897.

[2] *l. c.*

[3] *l. c.* and *Jahrb. k. k. geol. Reichsanst.* XXII. (1872), *Min. Mitth.* 58.

[4] *loc. cit.*

results are in agreement with those obtained by vom Rath[1] on heating the mineral from the same locality, which are as follows:—

Loss on heating up to 130°	10·05 per cent.
Further loss on heating up to 300°[2] ...	10·09 ,,
,, ,, till the salt melted	1·16 ,,
Total loss	21·30

The loss at 130°, as he remarked, is nearly half the total, and he consequently adopted the formula $MgSO_4.Na_2SO_4.2H_2O + 2aq.$

In respect to the Salt Range mineral, it was found that decomposition by loss of water commenced at about 85° C.; but, at even considerably higher temperatures, very protracted heating was necessary before the weight remained constant:—

Duration of heating.	Temp.	Loss per cent.	Total loss per cent.
39 hours	100° C.	9·44 (weight constant)	9·44
62 ,, more	110°	·37 (ditto)	9·81
114 ,, ,,	120°	·95 (ditto)	10·76

Thus at 120° exactly two molecules of water were driven off, and no further loss of weight took place on continued heating at the same temperature. But a very slight increase of temperature was sufficient to induce still further loss. After 16 hours at 125° this amounted to ·07 per cent., and after 27 hours longer at increasing temperatures up to 150°, to 1·05 per cent. more (total 11·88), these experiments not being continued till the weight was constant. When the mineral was heated at once to 150° 10·32 per cent. was expelled in 4 hours, but 12 hours more were required to raise the loss to 10·78, and the substance continued to lose water slowly when the heating was carried on still longer.

The Salt Range blödite, therefore, like the Stassfurt, loses two molecules of water more easily than the other two. The first were expelled between 85° and 120°, while the remainder began to go off at about 125°.

As long ago as 1842, Rose expressed the opinion that the blödite of certain salt lakes near Astrakhan was formed through the mutual decomposition of Epsom salt and common salt, whereby sodium sulphate and magnesium chloride result, the former uniting with the undecomposed Epsom salt.[3] Tschermak originally thought that the Hallstadt blödite

[1] *loc. cit.*

[2] Or 200? The original is not clear.

[3] *l. c*

was due to the alteration of polyhalite ; but later on he suggested that it was derived from kieserite.[1] Comparatively recently van't Hoff and van Deventer, incidentally to a research on transformation temperature in relation to chemical change, refer to two methods by which blödite may be formed artificially : firstly, by the combination of sodium sulphate with magnesium sulphate, and secondly, which is of more interest at present, by the double decomposition of magnesium sulphate and sodium chloride, according to the following equation :—

$$2SO_4Mg.7H_2O + 2NaCl = (SO_4)_2MgNa_2.4H_2O + MgCl_2.6H_2O + 4H_2O.$$

The transformation temperature with the salts in the above proportions is 31°C. Below this point the reaction from right to left occurs, but above it the reverse chemical change takes place, and blödite is formed together with magnesium chloride. The transformation temperature may, however, apparently be greatly lowered by the presence of common salt in excess, with which is probably connected "the technical prescription which forbids the transgression of a temperature of 5°, during the working of brine containing common salt and magnesium sulphate for glauber salt ; as above that temperature, according to the preceding experience, astrakanite (blödite) instead of glauber salt might separate out."[2]

In 1873, a lenticular band of mixed sylvine and kieserite was discovered by Dr. Warth in one of the beds of "*kallar*," or impure rock salt, of the Mayo mines. In a moist atmosphere the kieserite becomes disintegrated on the surface, and exhibits a constantly deciduous coating owing to its changing into epsomite.[3] As the latter mineral "impregnates the *kallar* and thin layers between the salt beds, and also effloresces from the surfaces of the red marl in old workings,"[4] it may perhaps be inferred that, although but one actual band of kieserite has been discovered, the mineral is still somewhat widely, if sparingly, distributed, in a scattered way, through the saline strata ; and there scarcely seems much room for doubting that the blödite has been formed by the solution and interaction of rock salt and the magnesian minerals just alluded to.

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[1] *l. c. & Sitzungsb. d. k. Akad. Wiss. Wien.* LXIII. 1 *Abth.* (1871), 321.

[2] *Zeit. f. physikalische Chemie*, I. (1887), 176.

[3] *Jahrb. d. k. k. geol. Reichanst*, XXIII, 2 *Abth.*, 136 ; *and Records, Geol. Surv. India*, VII, 64 ; *Memoirs, Geol. Surv. India*, XIV, 80.

[4] *Wynne, Memoirs, l. c.* 79.

On a new occurrence of Apophyllite in South Africa.

By J. A. Leo Henderson, M.E.

(Communicated by Prof. J. W. Judd, C.B., F.R.S.)

[Read April 6th, 1897.]

IN the so-called "blue ground" of the farm Koppiesfontein, in the neighbourhood of Jagersfontein, Orange Free State, a prospecting shaft was put down; and in the 110 ft. level struck a blue-grey, soft, and apparently talcose serpentine-like mass. The latter was densely studded with a great number of small, completely formed, light coloured crystals, which in some places lie very close together. The crystals may be easily isolated from this matrix, in which they leave smooth-sided and sharp-edged moulds. The isolated crystals are nearly colourless, or feebly yellowish, and strongly translucent; attain a maximum size of about $\frac{5}{16}$th inch (0·8 cm.), and are seldom smaller than $\frac{3}{16}$th inch (0·5 cm.), being therefore of almost uniform dimensions. At first sight one would be inclined to consider the eight-sided bi-pyramidal crystals as regular octahedra; however, apart from an inequality of the edges, one notes immediately, even in those individuals which are still imbedded in the hand-specimen, a perfect monotome cleavage cutting off two of the diametrically opposite four-edged solid angles, and forming very perfect smooth cleavage planes with brilliant pearly lustre. This behaviour first gave rise to the conjecture that the above-mentioned crystals were apophyllite. This, however, seemed to be contradicted by the fact that apophyllite generally occurs in crystals encrusting the matrix, whilst in this case the completely formed crystals are imbedded in the mother-rock. However, further mineralogical, physical and chemical investigations have proved that the mineral in question is beyond doubt apophyllite, which therefore occurs in this deposit under very unusual conditions.

Various difficulties presented themselves in the measurement of the crystal angles; such as the presence of hardly separable particles of the surrounding matrix on the faces of the isolated crystals, which rendered a perfect reflection impossible; further, the surfaces themselves were rough,

and in parts not quite regularly formed. Accordingly the measurements had to be executed with the aid of thin glass plates, fastened on to the surfaces. Even if the measurements may only be regarded as approximate (the extreme values gave differences up to $1\frac{1}{2}^{\circ}$), it was nevertheless found, from a large number of determinations, that the crystals, composed of eight triangular faces, possess only two kinds of edges, eight of which gave an angle of about 105°, the other four an angle of about 120°. The former value would correspond to the polar edge angle, the latter to the middle edge angle, of the proto-pyramid $P\{111\}$ of apophyllite. No forms other than the proto-pyramid P were observed on any of the many individuals examined. Often two individuals are found interpenetrating being apparently twinned on the same plan as that observed by Schrauf on the apophyllite crystals from Greenland, in which the axis of twinning is the normal to $P\{111\}$, a face of a more obtuse pyramid representing the plane of composition.

The specific gravity of the crystals, determined in Thoulet's solution by means of Westphal's balance, was found to be 2·371; thus agreeing with that of apophyllite. The hardness, again, is 4 to 4·5. The excellent basal cleavage, with its characteristic pearly lustre, has already been mentioned above. These thin basal cleavage plates are excellently adapted for examination in polarised light. As it is not necessary for the object of this communication to enter upon a detailed description of the optical phenomena, or even to compare the latter specially with the optical behaviour of the mineral from other localities lately investigated so exhaustively by C. Klein, it will be sufficient here to discuss only those phenomena which prove that the optical behaviour of the South African crystals lies within the limits of the phenomena already observed in apophyllite. Basal cleavage lamellæ of square form, examined under the microscope, reveal a colourless substance traversed by two dull grey lines which cross the crystals diagonally. These fine lines, visible even to the naked eye, seem to be composed of included substance from the surrounding matrix. As they correspond to the horizontal axes, a, in the basal plane, they divide the square lamella into four equal triangular quadrants. The small breadth of this layer of impurities imbedded in the plane of the axes, a, c, appears to be uniform in all the various lamellæ taken from the same crystal in different heights. In parallel polarised light, between crossed nicols, no position of the object gives total darkness. An isotropic square central field, as has sometimes been observed, does not present itself in any part of the crystals. In each of the four quadrants, thin polarising systems of bands appear on a dark ground, and lie more or less perpendicular to

the respective sides of the tetragonal sections, running together in the centre, at the point of intersection of the grey lines.

In convergent polarised light the interference figures in each of the four quadrants may be examined separately. They prove to be biaxial, with a very small optic angle, but still with a distinct separation of the hyperbolic brushes; the optic axial plane appears to be parallel to the corresponding side of the square section, so that in the two opposite quadrants the axial planes are parallel, while in two contiguous quadrants they are at right angles to each other. The lamellæ taken from different heights of the crystal proved themselves conformable to each other in every respect. The interference figure, with its approximately black and white rings, resembles in character that of leucocyclite.

The mineral fuses easily before the blowpipe; a splinter imparts the violet potassium colour to the flame. Heated in a closed tube, the mass exfoliates, gives off water in considerable quantity, and becomes opaque. The powdered mineral, moistened with water, gives a strong alkaline reaction with litmus, as well as with turmeric paper. Hydrochloric acid decomposes the powder with separation of slimy silica. The solution gives, with chloride of platinum, the microchemical reaction for potassium. In all these points it shows a behaviour completely identical with that of apophyllite.

An analysis of these crystals, made by Dr. Röhrig, of Leipzig, gave the following composition:—

SiO_2 ..	...	...	= 51·16
$Al_2O_3+Fe_2O_3$	...	...	= 1·60
CaO ...	...	...	= 25·44
MgO ...	...	...	= 0·29
K_2O ...	...	...	= 3·35
Na_2O ...	...	...	= 0·43
H_2O ...	...	...	= 16·73
F ...	...	...	= 1·04
NH_3 ...	...	...	= 0·11
			100·15

This analysis proves the mineral to be undoubtedly apophyllite, since it agrees very closely with the best analyses of this mineral. With regard to the amount of fluorine, in accordance with the results of Ch. Friedel (*Zeitschrift für Krystallographie* XXVI. 1896, p. 221), it was found that this apophyllite also does not give any fluorine by treatment with

sulphuric acid, but that if the mineral be treated with dilute hydrochloric acid, according to his method, and the filtrate precipitated with ammonia, a precipitate containing Ca, Si, and F is formed, from which SiF_4 can be obtained. On a plate of glass the name and locality of the mineral could be etched. The ammonia was driven off by decomposing the fine powder with dilute sulphuric acid, and by afterwards boiling with an excess of soda.

This occurrence of apophyllite is remarkable, on the one hand, because the crystalline form is solely confined to the development of P{111}; and on the other, because it occurs in an imbedded condition, instead of incrusting the matrix, as is more usually the case. Only two occurrences of imbedded apophyllite are, it appears, mentioned in the literature, namely, the "lenticular, more or less radially foliated," apophyllite described by J. Rumpf as imbedded in thin coaly strata, which lie in a decomposed basaltic tufa, near the church of S. Pietro, close to Montecchio-Maggiore (*Tscherm. Min. Mitth.* II. 1880, p. 388), and the xylochlore of Sartorius von Waltershausen (apophyllite, according to Kenngott), which was found in pyramidal crystals in a fossil tree trunk in the volcanic tufas of Halbjarnastadr Kambur, in N. Iceland (*Vulcan. Gesteine von Sicilien und Island*, 1853, p. 298). The nature of the surrounding matrix is, however, in South Africa quite different from that of the last-mentioned occurrences.

It is difficult to determine, from the scanty material at disposal, how far this matrix of the crystals, called "blue ground" at the place of discovery, corresponds with the well-known and much-discussed diamond-iferous "blue ground" of Kimberley. In favour of the similarity of the two deposits is the fact that from the "blue ground" of Koppies-fontein under discussion red garnets, particles of titanic iron ore and smaragdite were washed, which latter are characteristic of the Kimberley "blue ground." It is unknown to the author if the former is diamant-iferous; the "blue ground" of Jagersfontein is, as is well known, diamond bearing.

If the matrix of the crystals be finely pulverised, and placed in Thoulet's heavy solution, having a specific gravity of about 3, one observes in the scanty sediment a large number of sharp prismatic crystals of zircon, completely formed at both ends, and measuring up to 0·002″ (0·05 mm.) in length. An analysis of the Kimberley "blue-ground," by Flight gave I., whilst a not quite complete analysis of the apophyllite matrix yielded II.

	SiO_2.	Al_2O_3.	Fe_2O_3.	FeO.	MgO.	CaO.	CO_2.	H_2O.
I.	39·73	2·31	—	9·69	24·42	10·16	6·57	7·55
II.	34—35	15·44	3·55	14·80	7·16	10—11	—	11·34

Although considerable differences, especially in the amount of alumina and magnesia, appear, and though it would be difficult to ascribe a serpentinous character to the matrix of the crystals in Koppiesfontein, yet a certain geological analogy between the two materials is not excluded as impossible. Finally, it may be mentioned, that in the "blue-ground" of Kimberley also zeolites, chiefly mesolite and natrolite, are found.

A List of New Mineral Names.

By L. J. Spencer, M.A., F.G.S.

THE following is a list of recently published names, which are not to be found in the 6th edition (1892) of Dana's *System of Mineralogy*. Although it can scarcely be hoped to make such a list complete, it may still be useful for reference. Probably not more than a third of these are new minerals, which could, when completely determined, stand as distinct species.

Alexandrolite. S.M. Losanitsch, *Chem. News*, LXIX. 243, 1894; and *Ber. deutsch. chem. Ges.* XXVIII.(3), 2631, 1895.

A green, hydrated silicate of Al and Cr, resulting, with blue miloschine, from the decomposition of avalite. Servia.

Alexjejewite. A. Karnojitzky, *Zeits. Kryst. Min.* XXIV. 504, 1895 (V. Aleksyeev, *Verh. russ. min. Ges.* XXIX. 201, 1892). [This vol. p. 236.]

A wax-like hydrocarbon. Russia.

Andorite. J. A. Krenner, *Math. és term.-tud. Értesitö*, XI. 119, 1892. This vol. p. 286.

$2PbS.Ag_2S.3Sb_2S_3$. Rhombic. Hungary and Bolivia.

Ascharite. W. Feit, *Chemiker-Zeitung*, XV. 327, 1891.

$3Mg_2B_2O_5.2H_2O$. Ascherleben, Prussia.

Baddeleyite. L. Fletcher, *Nature*, XLVI. 620, 1892; XLVII. 283, 1892; *Min. Mag.* X. 148, 1893. E. Hussak, *Tsch. Min. Mitth.* XIV. 395, 1895. [This vol. p. 110.]

ZrO_2. Mono-symmetric. Ceylon and Brazil.

Bagotite. [T. Egleston, *Catalogue of Minerals*, (1887), 1889, p. 192; A. H. Chester, *Dictionary of the Names of Minerals*, 1896, p. 25; *Student's Index to the British Museum Collection of Minerals*, since 1885].

Green pebbles from Bagot, Ontario, have been in the British Museum since 1882; these are labelled bagotite, and are identified with the lintonite variety of thomsonite. Molybdenite comes from the same locality.

Barium anorthite. See celsian.

Barium heulandite (heulandite baritica). D. Lovisato, *Rend. R. Accad. Lincei*, VI.(1), 260, 1897.

Heulandite with 2·55 per cent. BaO. Sardinia.

Basiliite. L. J. Igelström, *Geol. För. Förh.* XIV. 307, 1892; and *Zeits. Kryst. Min.* XXII. 470, 1894.

Hydrated antimonate of manganese. Sjö mine, Sweden.

Batavite. E. Weinschenk, *Zeits. Kryst. Min.* XXVIII. 157-160, 1897.

A scaly decomposition product, perhaps related to the micas or chlorites. Bavaria.

Bismutosmaltine. A. Frenzel, *Tsch. Min. Mitth.* XVI. 524, 1897.

$Co(As,Bi)_3$. Cubic. Schneeberg, Saxony.

Bixbyite. S. L. Penfield and H. W. Foote, *Amer. Journ. Sci.* IV. 105, 1897.

Ferrous manganite. $FeO.MnO_2$. Cubic. Utah.

Bliabergite. L. J. Igelström, *Zeits. Kryst. Min.* XXVII. 603, 1897; spelt bliabergsite in *Geol. För. Förh.* XVIII. 41, 1896. M. Weibull, *Geol. För. Förh.* XVIII. 515, 1896.

Shown by Weibull to be a brittle mica near ottrelite. Bliaberg, Sweden.

Blueite. S. H. Emmens, *Journ. Amer. Chem. Soc.* XIV. 207, 1892; S. L. Penfield, *Amer. Journ. Sci.* XLV. 496, 1893.

Shown by Penfield to be nickeliferous pyrites. Sudbury, Canada.

Bouglisite. E. Cumenge [A. Lacroix, *Bull. Mus. d'Hist. Nat. Paris*, 1895, p. 42]. F. A. Genth, *Amer. Journ. Sci.* XLV. 32, 1893.

Described by Genth as a mixture of anglesite and gypsum. $2PbSO_4+CaSO_4+2H_2O$. Boleo, Lower California.

Brazilite. E. Hussak, *Neues Jahrb. Min.* II. 141, 1892; *Min. Mag.* X. 158; XI. 110.

Synonym of baddeleyite.

Burmite. F. Noetling, *Records Geol. Survey India*, XXVI. 31, 1893. O. Helm, *Ibid.* XXV. 180, 1892; XXVI. 61, 1893; and *Schriften Ges. Danzig*, VIII. 63, 1894.

An amber-like resin from Upper Burma.

Canfieldite. S. L. Penfield, *Amer. Journ. Sci.* XLVII. 451, 1894; XLVI. 107, 1893. [*Min. Mag.* X. 336; XI. 40.]

$4Ag_2S.(Sn,Ge)S_2$. Cubic. Bolivia.

Caswellite. A. H. Chester, *Trans. N.Y. Acad. Sci.* XIII. 181, 1894. [This vol. p. 243.]

An altered biotite, allied to clintonite. New Jersey.

Celsian. H. Sjögren, *Geol. För. Förh.* XVII. 578, 1895.

Barium anorthite. $BaO.Al_2O_3.2SiO_2$. Anorthic. Sweden.

Chloroarsenian. L. J. Igelström, *Geol. För. Föhr.* XV. 471, 1893; and *Zeits. Kryst. Min.* XXII. 468, 1894.

Arsenate of manganese? Sjö mine, Sweden.

Chondrostibian. L. J. Igelström, *Geol. För. Föhr.* XV. 343, 1893; and *Zeits. Kryst. Min.* XXII. 43, 1893.

Hydrated antimonate of manganese and iron. Sjö mine, Sweden.

Clinozoisite. See klinozoisite.

Cosmochlore. See kosmochlor.

Crossite. C. Palache, *Bull. Dept. Geol. Univ. Calif.* I. 181, 1894. [This vol. p. 35].

A soda amphibole between riebeckite and glaucophane. California.

Cubaite. F. Vidal y Careta, *Cronica Cientifica, Barcelona*, XIII. 497, 1890; L. F. Navarro, *Anal. Soc. Espan. Hist. Nat.* XXI. *Actas*, p. 120, 1893.

A supposed cubic form of silica; shown by Navarro to be rhombohedra of quartz. See guanabaquite.

Cumengeite. E. Mallard, *Bull. Soc. fran. Min.* XVI. 184, 1893; E. Cumenge, *Compt. Rend.* CXVI. 898, 1893; A. Lacroix, *Bull. Mus. d'Hist. Nat. Paris*, 1895, p. 39. This vol. p. 164.

$PbCl_2.CuO.H_2O$. Tetragonal. Boleo, Lower California.

Cuprocassiterite. T. Ulke, *Trans. Amer. Inst. Mining Engineers*, XXI. 240, 1892; W. P. Headden, *Amer. Journ. Sci.* XLV. 108, 1893.

"$4SnO_2 + Cu_2Sn(OH)_6$." Shown by Headden to be a decomposition product of stannite. S. Dakota.

Cuproiodargyrite (Cupro-Jodargyrit). H. Schulze, *Chemiker-Zeitung*, XVI. 1952, 1892.

CuI.AgI. Chili.

Derbylite. E. Hussak and G. T. Prior, *Min. Mag.* XI. 176, 1897; XI. 85, 1895.

$FeO.Sb_2O_5+5(FeO.TiO_2)$. Rhombic. Brazil.

Dicksbergite. L. J. Igelström, *Geol. För. Förh.* XVIII. 231, 1896.

Shown by M. Weibull and A. Upmark (*Ibid.* XVIII. 523, 1896) to be rutile. Dicksberg, Sweden.

Dietzeite. A. Osann, *Zeits. Kryst. Min.* XXIII. 588, 1894. To replace Dietze's name jodchromate (*Ibid.* XIX. 449, 1891).

$7Ca(IO_3)_2.8CaCrO_4$. Monosymmetric. Chili.

Dundasite. W. F. Petterd, *Catalogue of Minerals of Tasmania*, 1893, p. 26; and *Papers and Proc. Roy. Soc. Tasmania*, for 1893, 26, 1894.

"Hydrous carbono-phosphate of lead and alumina."

Elfstorpite. L. J. Igelström, *Geol. För. Förh.* XV. 472, 1893, and *Zeits. Kryst. Min.* XXII. 468, 1894.

Hydrated arsenate of manganese? "Rhombic." Sjö mine, Sweden.

Elpidite. G. Lindström, *Geol. För. Förh.* XVI. 330, 1894; G. Nordenskiöld, *Ibid.* p. 343.

$Na_2O.ZrO_2.6SiO_2.3H_2O$. Rhombic. Greenland.

Epididymite. G. Flink, *Geol. För. Förh.* XV. 201, 1893; and *Zeits. Kryst. Min.* XXIII. 353, 1894. [This vol. p. 100.]

$BeNaHSi_3O_8$. Rhombic. Greenland.

Fluor-adelite. See tilasite.

Folgerite. S. H. Emmens, *Journ. Amer. Chem. Soc* XIV. 205, 1892; S. L. Penfield, *Amer. Jour. Sci.* XLV. 491, 1893.

Shown by Penfield to be identical with pentlandite. Sudbury, Canada.

Franckeite. A. W. Stelzner, *Neues. Jahrb. Min.* II. 114, 1893.

$5PbS.2SnS_2.Sb_2S_3$. Bolivia.

Fuggerite. E. Weinschenk, *Zeits. Kryst. Min.* XXVII. 577, 1897.

Tetragonal? Between åkermanite and gehlenite in composition, but dimorphous with this group. Tyrol.

Geikielite. A. B. Dick, *Min. Mag.* X. 145, 1893; L. Fletcher, *Nature*, XLVI. 620, 1892.

$MgO.TiO_2$. Ceylon.

Gersbyite. L. J. Igelström, *Zeits Kryst. Min.* XXVIII. 310, 1897.

Near lazulite. Sweden.

Gonnardite. A. Lacroix, *Bull. Soc. fran. Min.* XIX. 426, 1896. F. Gonnard, *Compt. Rend.* LXXIII. 1147, 1871.

A zeolite. $(Ca,Na_2)_2Al_2Si_3O_{15}+5\frac{1}{2}H_2O$? Rhombic. Described by Gonnard as mesolite, but it differs from this optically. Puy-de-Dôme.

Graphitite. W. Luzi, *Zeits. f. Naturwiss.* LXIV. 257, 1891, and *Ber. deutsch. chem. Ges.* XXIV. 2), 4093, 1891 (1892); E. Weinschenk, *Zeits. Kryst. Min.* XXVIII. 291, 1897.

A variety of graphite which does not swell up when moistened with nitric acid and ignited. Weinschenk considers it to be merely graphite.

Guanabacoite. See guanabaquite.

Guanabaquite. F. Vidal y Careta, *Crónica Científica, Barcelona*, XIV. 268, 1891.

Given to replace the name cubaite (*q. v.*) for the "cubical quartz" of Guanabacoa, Cuba.

Also includes the "cubical chalcedony" of the same locality (*Ibid.* XIV. 268, 273, 1891; XIII. 293, 1890); this is shown by L. F. Navarro (*Anal. Soc. Espan. Hist. Nat.* XXI. *Actas*, p. 120, 1893,) to be pseudomorphous, possibly after fluorite.

Hainite. J. Blumrich, *Tsch. Min. Mitth.* XIII. 472, 1893.

Silicate of Na,Ca,Ti,Zr. Anorthic. Related to rosenbuschite, &c. Phonolites of N. Bohemia.

Hamelite. T. S. Hunt, *Mineral Physiology and Physiography*, 1886, pp. 194, 334; *Trans. Roy. Soc. Canada*, IV.(3), 9, (1886), 1887.

Hydrated silicate of Al,Fe,Mg. New Brunswick.

Hastingsite. F. D. Adams and B. J. Harrington, *Amer. Journ. Sci.* I. 212, 1896; and *Canadian Record Sci.* VII. 81, 1896. [This vol. p. 244.]

A soda hornblende with the orthosilicate formula $(R',R'')_3R_2'''Si_4O_{12}$. Monosymmetric. Hastings Co., Ontario.

Hauchecornite. R. Scheibe, *Jahrb. preuss. geol. Landesanst. u. Bergakad.*, for 1892, XII. 91, 1893; H. Laspeyres, *Verh. naturhist. Ver. Bonn*, L. 177, 1893. [*Min. Mag.* X. 339.]

$Ni_{11}SbBi_2S_{13}$ or $(Ni,Co,Fe)_7(S,Bi,As,Sb)_8$. Tetragonal. Rhenish Prussia.

Hautefeuillite. L. Michel, *Compt. Rend.* CXVI. 898, 1893; and *Bull. Soc. fran. Min.* XVI. 38, 1893. [This vol. p. 162.]

$(Mg,Ca)_3(PO_4)_2+8H_2O$. Monosymmetric. Norway.

Heazlewoodite. W. F. Petterd, *Catalogue of Minerals of Tasmania*, 1896.

Sulphide of Ni and Fe, related to pentlandite.

Hemiopal. H. H. A. Francke, *Min. Nomenklatur*, 1890, p. 81.

Syn. of halbopal and semiopal.

Heulandite baritica. See barium heulandite.

Hoeferite. F. Katzer, *Tsch. Min. Mitth.* XIV. 519, 1895. [This vol. p. 161.]

$2Fe_2O_3.4SiO_2.7H_2O$. Related to the chloropals. Bohemia.

Hydrocalcite. H. B. Kosmann, *Zeits. deutsch. geol. Ges.* XLIV. 155, 1892.

$CaCO_3.2H_2O$. Silesia.

Iddingsite. A. C. Lawson, *Bull. Dept. Geol. Univ. Calif.* I. 31, 1893. F. L. Ransome, *Ibid.* I. 90, 1893. H. H. Arnold-Bemrose, *Quart. Journ. Geol. Soc.* L. 617, 1894. [*Min. Mag.* X. 264.]

Hydrated silicate of Fe,Ca,Mg and Na. Rhombic. Possibly a pseudomorph after olivine. California.

Idrizite. A. Schrauf, *Jahrb. k. k. geol. Reichsanst.* XLI. 379, 1892.

$(Mg_6,Fe)SO_4+(Al_5,Fe_3)_2S_2O_9+16H_2O$. Nearer to quetenite and botryogen than to pickeringite and halotrichite. Idria, Carniola.

Jarrowite. [G. A. Lebour, *57th Rept. Brit. Assoc.* for 1887, 700, 1888]. *British Museum Student's Index*, since 1886. H. A. Miers, this vol. p. 264.

Syn. of thinolite. Jarrow, Durham.

Jodchromate. See dietzeite.

Josephinite. W. H. Melville, *Amer. Journ. Sci.* XLIII. 509, 1892.

A nickel iron, Fe_2Ni_5, possibly meteoric. Josephine Co. Oregon.

Kaliastrakanite. A. Naupert and W. Wense, *Ber. deutsch. chem. Ges.* XXVI.(1), 873, 1893; C. A. Tenne, *Zeits. deutsch. geol. Ges.* XLVIII. 632, 1896. The name kalium-astrakanite had previously been used by J. K. van der Heide (*Ber. deutsch. chem. Ges.* XXVI.(1), 414, 1893) for the artificial salt. See leonite.

$MgSO_4.K_2SO_4+4H_2O$. Monosymmetric. Prussian salt deposits.

Kaliblödite. Mentioned by C. A. Tenne, *Zeits. deutsch. geol. Ges.* XLVIII. 632, 1896.

Syn. of kaliastrakanite.

Kamarezite. K. Busz, *Verh. naturhist. Ver. Bonn*, L. *Sitz.-ber.* p. 83, 1893; and *Neues Jahrb. Min.* I. 115, 1895. [This vol. p. 108.]

$3CuO.SO_3.8H_2O$. Rhombic. Kamareza, Greece.

Kauaiite. E. Goldsmith, *Proc. Acad. Nat. Sci. Philadelphia*, 105, 1894. [This vol. p. 166.]

$2Al_2O_3.3(K,Na,H)_2O.SO_3$. Hawaii.

Kehoeite. W. P. Headden, *Amer. Journ. Sci.* XLVI. 22, 1893.

$(Zn_{\frac{3}{4}}+Ca_{\frac{1}{4}})_3P_2O_8+2Al_2(OH)_6+21H_2O$. S. Dakota.

Keramite. T. S. Hunt, *Mineral Physiology and Physiography*, 1886, p. 371; and *Trans. Roy. Soc. Canada*, III.(3), 76, (1885) 1886

A clay resulting from the alteration of scapolite. Bavaria.

Klinozoisite. E. Weinschenk, *Zeits. Kryst. Min.* XXVI. 161, 1896. [This vol. p. 237.]

Epidote containing only a little iron, and so agreeing with zoisite in composition. $H_2Ca_4Al_6Si_6O_{26}$. Monosymmetric. Tyrol.

Knopite. P. J. Holmqvist, *Geol. För. Förh.* XVI. 73, 1894. [This vol. p. 158.]

$CaO.TiO_2$ with some Ce_2O_3. Pseudo-cubic. Alnö, Sweden.

Kosmochlor. H. Laspeyres, *Zeits. Kryst. Min.* XXVII. 592, 1897.

Silicate of Cr &c. Probably monosymmetric. From the Toluca meteoric iron.

Kylindrite. A. Frenzel, *Neues Jahrb. Min.* II. 125, 1893.

$6PbS.Sb_2S_3.6SnS_2$ Bolivia.

Lamprostibian. L. J. Igelström, *Geol. För. Förh.* XV. 471, 1893; and *Zeits. Kryst. Min.* XX. 467, 1894.

Antimonate of Fe and Mn. Sjö mine, Sweden.

Langbeinite. S. Zuckschwerdt, *Zeits. angewandte Chem.* 356, 1891. O. Lüdecke, *Chemiker-Zeitung*, XXI. 264, 1897.

$K_2SO_4.2MgSO_4$. Cubic, tetartohedral (Lüdecke). Prussian salt deposits.

Lawsonite. F. L. Ransome, *Bull. Dept. Geol. Univ. Calif.* I. 301, 1895; and F. L. Ransome and C. Palache, *Zeits. Kryst. Min* XXV. 531, 1896. [This vol. p. 157.]

$CaO.Al_2O_3.2SiO_2.2H_2O$. Rhombic. California. Piedmont (*Bull. Soc. fran. Min.* XX. 5. 1897). Corsica (*Ibid.* p. 110).

Lembergite. A. Lagorio, *Trav. Soc. Natural. Varsovie, Ann.* VI. *Livr.* XI. 7, 1895. [Abstract in *Zeits. Kryst. Min.* XXVIII. 526, 1897.] J. Lemberg, *Zeits. deutsch. geol. Ges.* XXXIX. 562, 1887. [This vol. p 111.]

Given to Lemberg's artificial "Natronnephelinhydrat."

$4Na_2Al_2Si_2O_8+5H_2O$. Rhombic.

Leonite. C. A. Tenne, *Zeits. deutsch. geol. Ges.* XLVIII. 632, 1896.

To replace kalnastrakanite (*q.v.*).

Lewisite. E. Hussak and G. T. Prior, *Min. Mag.* XI. 80, 1895.

$5(Ca,Fe)O.3Sb_2O_5.2TiO_2$. Cubic. Brazil.

Lindesite. L. J. Igelström, *Zeits. Kryst. Min.* XXIII. 590, 1894. H. Sjögren, *Bull. Geol. Inst. Upsala*, II. 84, 132, 1895. [This vol. pp. 105, 168.]

Shown by Sjögren to be identical with urbanite.

Lorandite. J. A. Krenner, *Math. és term.-tud. Értesitö*, XII. 473, 1894; XIII. 258, 1895; Abstract in *Zeits. Kryst. Min.* XXVII. 98, 1896. [This vol. pp. 32, 168.]

$Tl_2S.As_2S_3$. Monosymmetric. Macedonia.

Lossenite. L. Milch, *Zeits. Kryst. Min.* XXIV. 100, 1894. [This vol. p. 106.]

$2PbSO_4+6(FeOH)_3As_2O_8+27H_2O$. Rhombic. Laurion, Greece.

Lutecite. A. Michel-Lévy and Munier-Chalmas, *Bull. Soc. fran. Min.* XV. 174, 1892. F. Wallerant, *ibid.* XX. 57, 1897. [*Min. Mag.* X. 256].

A fibrous form of silica.

Mackintoshite. W. E. Hidden and W. F. Hillebrand, *Amer. Journ. Sci.* XLVI. 98, 1893. [*Min. Mag.* X. 341].

$UO_2.3ThO_2.3SiO_2.3H_2O$. Tetragonal. Llano Co., Texas.

Magnetostibian L. J. Igelström, *Zeits. Kryst. Min.* XXIII. 212, 1894.

Antimonate of Mn and Fe. Sjö mine, Sweden.

Magnofranklinite. *Geol. Survey, New Jersey, Final Rept.* II. (1), 14, 1892. A. H. Chester, *Dictionary of the Names of Minerals*, 1896, p. 164.

A local name for the franklinite of Sterling Hill, N.J., which contains little zinc and is highly magnetic.

Maltesite. J. J. Sederholm, *Geol. För. Förh.* XVIII. 390, 1896.

A variety of andalusite resembling chiastolite. Finland.

Manganandalusite. H. Bäckström, *Geol. För. Förh.* XVIII. 386, 1896.

A variety of andalusite containing 6·91 per cent. Mn_2O_3. Sweden.

Mangankiesel. F. Klockmann, *Jahrb. k. preuss. geol. Landesanst. u. Bergakad.* for 1894, XV. p. xxxii. 1895.

A quartz-schist containing much $MnCO_3$. Harz.

Marshite. A Liversidge, *Journ. and Proc. Roy. Soc. N.S. Wales*, XXVI. 328, 1892; abstract by H. A. Miers, *Zeits. Kryst. Min.* XXIV. 207, 1894. [This vol. p. 236.]

Copper iodide. Cubic (Miers). Broken Hill, N.S.W.

Masrite. H. D. Richmond and H. Off, *Journ. Chem. Soc. Trans.* LXI. 491, 1892.

A fibrous alum containing "the element masrium." Egypt.

Mauzeliite. H. Sjögren, *Geol. För. Förh.* XVII. 313, 1895. [This vol. pp. 82, 229.]

$4(Ca,Pb)O.2Sb_2O_5.TiO_2$. Cubic. Sweden.

Melanostibian. L. J. Igelström, *Geol. För. Förh.* XIV. 583, 1892; and *Zeits. Kryst. Min.* XXI. 246, 1893.

Antimonite of Mn and Fe. Sjö mine, Sweden.

Mesabite. H. V. Winchell, *Trans. Amer. Inst. Mining Engineers*, XXI. 660, 1893.

The ochreous göthite abundant at Mesabi, Minnesota.

Metadesmine. F. Rinne, *Neues Jahrb. Min.* I. 57, 1897. [This vol. p. 343.]

Given to the substances of definite chemical composition and optical properties produced when water is artifically expelled from stilbite (=desmine).

Metanocerite. F. v. Sandberger, *Neues Jahrb. Min.* I. 221, 1892.

A mineral resembling nocerite. Arendal, Norway.

Metascolezite. F. Rinne, *Neues Jahrb. Min.* II. 60, 1894.

A dehydrated form of scolecite. $CaAl_2Si_3O_{10}+2H_2O$. Monosymmetric.

Minervite. A. Gautier, *Compt. Rend.* CXVI. 1173, 1893.

$Al_2O_3.P_2O_5.7H_2O$. A. Carnot (*Ann. des Mines*, VIII. 311, 1895) gives it as a phosphate of Al and K Grotte de Minerve, France.

Munkforssite. L. J. Igelström. *Zeits. Kryst. Min.* XXVII. 601. 1897. Spelt munkforsite, *Ibid.* XXVIII. 310, 1897.

Phosphate and sulphate of Ca and Al; resembles svanbergite. Sweden.

Munkrudite. L. J. Igelström. *Zeits. Kryst. Min.* XXVIII. 310, 1897.

Phosphate and sulphate of Fe and Ca; resembles svanbergite. Munkerud, Sweden.

Natron-berzeliite. H. Bäckström, *Zeits. Kryst. Min.* XXVI. 102, 1896 (abstract of H. Sjögren's paper).

Syn. of soda-berzeliite (*q. v.*).

Natronrichterite. H. Sjögren, *Geol. För. Förh.* XIV. 253, 1892.

See soda-richterite.

Neptunite. G. Flink, *Geol. För. Förh.* XV. 196, 1893; and *Zeits. Kryst. Min.* XXIII. 346, 1894. O. Sjöström, *Geol. För. Förh.* XV. 393, 1893. [This vol. p. 100.]

$(Fe,Mn)O.(Na,K)_2O.4SiO_2.TiO_2$. Monosymmetric. Greenland.

Nickel-skutterudite. E. Waller and A. J. Moses, *School of Mines Quart.* XIV. 49, 1892.

(Ni,Co,Fe)As_3. New Mexico.

Northupite. W. M. Foote, *Proc. Acad. Nat. Sci. Philadelphia*, 1895, 408, 1896; and *Amer. Journ. Sci.* L. 480, 1895. J. H. Pratt, *Amer. Journ. Sci.* II. 124, 1896; and *Zeits. Kryst. Min.* XXVII. 418, 1896. [This vol. pp. 159, 226.]

$MgCO_3.Na_2CO_3.NaCl$. Cubic. California.

Pearceite. S. L. Penfield, *Amer. Journ. Sci.* II. 17, 1896; and *Zeits. Kryst. Min.* XXVII. 65, 1896. [This vol. p. 224.]

A name for the arsenical varieties of polybasite. $9Ag_2S.As_2S_3$. Monosymmetric.

Penfieldite. F. A. Genth, *Amer. Journ. Sci.* XLIV. 260, 1892. S. L. Penfield, *Ibid.* XLVIII. 114, 1894. [This vol. p. 43.]

$PbO.2PbCl_2$. Hexagonal. Laurion, Greece.

Pirssonite. J. H. Pratt, *Amer. Journ. Sci.* II. 126, 1896; and *Zeits. Kryst. Min.* XXVII. 420, 1896. [This vol. p. 226.]

$CaCO_3.Na_2CO_3.2H_2O$. Rhombic. California.

Potash-richterite. H. Sjögren, *Bull. Geol. Inst. Upsala*, II. 77, 1895.

The original richterite analysed by Michaelson in 1863.

Prolectite. H. Sjögren, *Bull. Geol. Inst. Upsala*, II. 99, 1895. [This vol. pp. 139, 161.]

Probably $Mg[Mg(F,OH)]_2\,SiO_4$. Monosymmetric. Sweden.

Pseudoboleite. A. Lacroix, *Bull. Mus. d'Hist. Nat. Paris*, p. 39, 1895.

Between boleite and cumengeite. Boleo, Lower California.

Pseudopyrophyllite. F. Löwinson-Lessing, *Verh. russ. min. Ges.* XXXIII. 283, 1895.

$3MgO.4Al_2O_3.9SiO_2.8H_2O$. Rhombic. Urals.

Quartzine. A. Michel-Lévy and Munier-Chalmas, *Bull. Soc. fran. Min.* XV. 166, 1892; F. Wallerant, *Ibid.* XX. 52, 1897. [*Min. Mag.* X. 254.]

A fibrous form of silica.

Quiroguite. L. F. Navarro, *Anal. Soc. Españ. Hist. Nat.* XXIV. *Actas*, p. 96, 1895. Spelt quirogite in abstracts in *Zeits. Kryst. Min.* XXVIII. 202, 1897; *Neues Jahrb. Min.* I. 452, Ref. 1897; *Bull. Soc. fran. Min.* XX. 163, 1897. [This vol. p. 241]

$23PbS.3Sb_2S_3$. Tetragonal. Spain. Probably only galena.]

Ransätite. L. J. Igelström, *Geol. För. Förh.* XVIII. 43, 1896; and *Zeits. Kryst. Min.* XXVII. 604, 1897.

"$3(Mn,Ca,Mg)SiO_3+(Fe,Al)_4Si_3O_{12}$." "Cubic." Sweden.

Raphite. H. How. [T. Egleston, *Catalogue of Minerals*, (1887), 1889, p. 144. A. H. Chester, *Dictionary of the Names of Minerals*, 1896, p. 227. In the British Museum since 1879.]

Synonym of ulexite.

Rathite. H. Baumhauer, *Zeits. Kryst. Min.* XXVI. 593, 1896. [This vol. p. 225.]

A sulpho-salt of Pb,As (and Sb). Rhombic. Binnenthal, Switzerland.

Retzian. H. Sjögren, *Bull. Geol. Inst. Upsala*, II. 54, 1895; *Geol. För. Förh.* XIX. 106, 1897. [This vol. p. 167.]

Hydrated basic arsenate of Mn and Ca; near flinkite. Rhombic. Sweden.

Rhodoarsenian. L. J. Igelström, *Zeits. Kryst. Min.* XXII. 469, 1892.

Hydrated basic arsenate of Mn,Ca and Mg. Sjö mine, Sweden.

Rhodophosphite. L. J. Igelström, *Zeits. Kryst. Min.* XXV. 433, 1895.

Phosphate of Ca, (Mn and Fe) with chloride and sulphate. Sweden. [Part of the analysis given for this has been published (*Bull. Soc. fran. Min.* V. 303, 1882) for manganapatite.]

Rhodusite. H. v. Foullon, *Ber. Akad. Wien*, C. (1), 144, 1891. Asbestiform glaucophane. Island of Rhodes.

Rœblingite. S. L. Penfield and H. W. Foote, *Amer. Journ. Sci.* III. 413, 1897. [This vol. p. 343.]

$5(H_2CaSiO_4)+2(CaO.PbSO_3)$. New Jersey.

Salvadorite. W. Herz, *Zeits. Kryst. Min.* XXVI. 16, 1896. [This vol. p. 240.]

$FeCu_2(SO_4)_3+21H_2O$. Monosymmetric. Chili.

Schulzenite. P. Martens, *Actes Soc. Sci. Chili*, V. 87, 1895.

$CuO.2CoO.Co_2O_3.4H_2O$. Resembles wad. Chili ?

Seelandite. A. Brunlechner, *Jahrb. naturh. Landes-Museums, Klagenfurt*, XXII. 192, 1893; "*Carinthia*," *Klagenfurt*, No. 2, 1891.

$MgO.Al_2O_3.4SO_3.27H_2O$. Near pickeringite. Carinthia.

Siderotil. A. Schrauf, *Jahrb. k. k. geol. Reichsanst.* XLI. 380, 1892.

$FeSO_4+5H_2O$. Idria, Carniola.

Sjögrufvite. L. J. Igelström, *Geol. För. Förh.* XIV. 309, 1892; *Zeits. Kryst. Min.* XXII. 471, 1894.

Hydrated arsenate of Mn and Fe. Sjö mine, Sweden.

Soda-berzeliite. H. Sjögren, *Bull. Geol. Inst. Upsala*, II. 92, 1895. [This vol. p. 163.]

$10RO.3As_2O_5$ or $3RO.As_2O_5$. Cubic. Sweden.

Soda-richterite. H. Sjögren, *Bull. Geol. Inst. Upsala*, II. 71, 1895.

To replace the name astochite (*Geol. För. Förh.* XIII. 604, 1891). See natronrichterite.

Stevensite. A. R. Leeds. [A. H. Chester, *Dictionary of the Names of Minerals*, 1896, p. 257.]

Talc pseudomorphous after pectolite.

Stiberite. H. How. [T. Egleston, *Catalogue of Minerals*, 3rd edit. 1892, p. 328. A. H. Chester, *Dictionary of the Names of Minerals*, 1896, p. 257. In the British Museum since 1879.]

Syn. of ulexite.

Stibiotantalite. G. A. Goyder, *Journ. Chem. Soc. Trans.* LXIII. 1076, 1893.

$(Ta,Nb)_2O_5.Sb_2O_3$[?] Rhombic ? Western Australia.

Sulfoborite. A. Naupert and W. Wense, *Ber. deutsch. chem. Ges.* XXVI.(1), 874, 1893. H. Bücking, *Ber. Akad. Berlin*, 967, 1893. K. Thaddéeff, *Zeits. Kryst. Min.* XXVIII. 264, 1897. [This vol. p. 103.]

$3MgSO_4.2Mg_3B_4O_9.12H_2O$. According to Thaddéeff—
$MgSO_4.Mg_2B_2O_5.4\frac{1}{2}H_2O = 4MgHBO_3 + 2MgSO_4 + 7H_2O$.

Rhombic (Bücking). Prussian salt deposits.

Sundtite. W. C. Brögger, *Forh. Vid.-Selsk. Christiania*, for 1892, No. 18, 1893. This vol. p. 286.

Syn. of andorite.

Talc-knebelite. See talkknebelite.

Talkknebelite. L. J. Igelström, *Neues Jahrb. Min.* I. 248, 1890.

Knebelite with 4·7 per cent. MgO. Sweden.

Taraspite. C. v. John. *Verh. k. k. geol. Reichsanst.* p. 67, 1891.

Syn. of miemite (var. of dolomite). Tarasp, Switzerland.

Tetragophosphite. L. J. Igelström, *Zeits. Kryst. Min.* XXV. 433, 1895.

Slightly more basic than lazulite. Sweden.

Tiffanyite. G. F. Kunz, *Trans. N. Y. Acad. Sci.* XIV. 260, 1895. [This vol. p. 241.]

A hydrocarbon to which is attributed the phosphorescence of diamonds.

Tilasite. H. Sjögren, *Geol. För. Förh.* XVII. 291, 1895. [This vol. p. 229.]

Fluor-adelite. $2CaO.MgO.MgF_2.As_2O_5$. Anorthic. Sweden.

Tripuhyite. E. Hussak and G. T. Prior, *Min. Mag.* XI. 302, 1897.

$2FeO.Sb_2O_5$. Tripuhy, Brazil.

Urbanite. H. Sjögren, *Geol. För. Förh.* XIV. 251, 1892; and *Bull. Geol. Inst. Upsala*, II. 77, 106, 1895. [This vol. p. 167.]

A monosymmetric pyroxene. $(Ca,Mg)O.SiO_2+Na_2O.Fe_2O_3.4SiO_2$.

Utahlite. G. F. Kunz, 16*th Ann. Rept. U. S. Geol. Survey*, for 1894-5, Pt. IV. 602, 1895.

The compact nodular variscite from Cedar Valley, Utah.

Valleite. G. Cesàro, *Bull. Acad. Belg.* XXXII. 536, 1896; XXIX. 508, 1895. [This vol. p. 228.]

A rhombic amphibole near anthophyllite. $(Mg,Ca)O.SiO_2$. New York.

Wardite. J. M. Davison, *Amer. Journ. Sci.* II. 154, 1896. [This vol. p. 226.]

$P_2O_5.2Al_2O_3.4H_2O$. Utah.

Webnerite. A. W. Stelzner, *Zeits. Kryst. Min.* XXIV. 125, 1894. This vol. p. 286.

Syn. of andorite.

Weldite. W. F. Petterd, *Catalogue of Minerals of Tasmania*, 1896.

Silicate of Al and Na.

Wellsite. J. H. Pratt and H. W. Foote, *Amer. Journ. Sci.* III. 443. 1897.

$(Ba,Ca,K_2)O.Al_2O_3.3SiO_2+3H_2O$. Monosymmetric. Related to phillipsite. North Carolina.

Whartonite. S. H. Emmens, *Journ. Amer. Chem. Soc.* XIV. 209, 1892. S. L. Penfield, *Amer. Journ. Sci.* XLV. 496, 1893.

Shown by Penfield to be nickeliferous pyrites. Sudbury, Canada.

Willyamite. E. F. Pittman, *Journ. and Proc. Roy. Soc. N. S. Wales*, XXVII. 366, 1893. [This vol. p. 236.]

$CoS_2.NiS_2.CoSb_2.NiSb_2$. Cubic. Broken Hill, N.S.W.

Xiphonite G. Platania, *Atti Accad. Sci. Acireale*, V. 55, 1893. [This vol. p. 168.]

A variety of amphibole. Monosymmetric. Etna.

Zinkmanganerz. A. Brunlechner, *Jahrb. naturh. Landes-Museums, Klagenfurt*, XXII. 194, 1893.

Hydrated manganate of zinc. Carinthia.

Zirkelite. E. Hussak and G. T. Prior, *Min. Mag.* XI. 86, 1895; XI. 180, 1897.

$(Ca,Fe)O.2(Zr,Ti,Th)O_2$. Cubic. Brazil.

August, 1897.

ABSTRACTS

The Identity of Chalcostibite (Wolfsbergite) and Guejarite. (S. L. Penfield and A. Frenzel, *Amer. Journ. Sci.*, IV, 27-35, July 1897, 4 figs.; and *Zeits. Kryst. Min.* XXVIII, 598, 1897).—The identity of chalcostibite and guejarite, first suggested before this Society,[1] has now, from a re-examination of the original material, been conclusively proved.

The mineral was first described, from Wolfsberg in the Harz, by Zincken in 1835, under the name Kupferantimonglanz; it was determined by G. Rose to be orthorhombic, but terminal faces were wanting on the prismatic crystals; and an analysis by H. Rose gave to it the formula $Cu_2S.Sb_2S_3$. The name chalcostibite was proposed by Glocker in 1847, and wolfsbergite was given by Nicol two years later; although the latter is perhaps the more familiar name, the present authors adopt, with Dana, the older name chalcostibite. It was not until much later (1891) that a more complete crystallographic description of the mineral was given by Laspeyres.

"Guejarite" was described in 1879 by E. Cumenge[2] from Güejar-Sierra, on the northern slopes of the Sierra Nevada, Spain. The results of his analysis, which were only given to half per cents., led to the formula $Cu_2S.2Sb_2S_3$. C. Friedel noticed at the time that the crystallographic measurements of the prism zone were in agreement with the only zone then known for chalcostibite, but it was only the later measurements of Laspeyres that showed the complete crystallographic identity of chalcostibite and guejarite. Here it may be mentioned that Breithaupt in 1857 described chalcostibite from the "guejarite" locality,[3] giving an analysis and an angular measurement. This was apparently overlooked by Cumenge, nor is it mentioned by the present authors.

The position adopted by Friedel for the guejarite crystals was the same as Rose's position for chalcostibite, the striated prismatic zone being

[1] "On wolfsbergite (chalcostibite) from Bolivia, and the probable identity of wolfsbergite and guejarite," by L. J. Spencer. Read April 14th, 1896. See this volume, pp. x, 190.

[2] Abstract in *Min. Mag.*, IV, 64.

[3] The locality, Lanteira, given by Breithaupt, is about 16 or 18 miles to the east of Güejar-Sierra.

placed vertically and the perfect cleavage being $b\{010\}$. When placed in the new position,[1] in which the prismatic zone is parallel to the macroaxis b and the perfect cleavage is $c\{001\}$, the forms given by Friedel have the following indices:—$c\{001\}$, $b\{010\}$, $g\{201\}$, $i\{302\}$, $d\{101\}$, $h\{203\}$, $n\{061\}$, $t\{021\}$; and, from his measurements, the axial ratios become—

$$a : b : c : = 0{\cdot}5242 : 1 : 0{\cdot}6377.$$

From an examination of Cumenge's original material, the present authors show that the crystallographic measurements agree closely with Friedel's determinations, but that the analyses (II, III and IV by Frenzel) are in accordance with the formula $Cu_2S.Sb_2S_3$, and not $Cu_2S.2Sb_2S_3$, as given by Cumenge. The excess of antimony shown in Cumenge's analysis (quoted under I below) was probably due to the presence of stibnite,[2] which, as noted by Cumenge himself, closely resembles chalcostibite in colour, lustre, habit and cleavage. In collecting material for the present analyses each crystal was qualitatively tested for copper, in order to make sure that no stibnite was present.

	I. (Cumenge.)	II.	III.	IV.	V.	VI.	VII. (Calculated.)
S ...	25·0	26·28	—	26·12	25·29	26·20	25·87
Sb ...	58·5	48·86	48·50	48·44	48·30	48·45	48·50
Cu ...	15·5	24·44	25·92	25·23	25·36	24·72	25·63
Pb ...	trace	0·58	—	0·32	—	—	—
Fe ...	0·5	0·42	—	0·49	1·23	—	—
Zn ...	—	—	—	0·18	—	—	—
	99·5	100·58		100·78	100·18	99·37	100·00
Sp. gr....	5·03	4·96	—	—	5·015	—	—

Under V is given T. Richter's analysis of Breithaupt's Spanish chalcostibite; and under VII the calculated percentage composition of $Cu_2S.Sb_2S_3$.

Chalcostibite from Bolivia. The identity of chalcostibite and guejarite was in the first place suggested by the examination of a specimen sent to the British Museum labelled as guejarite. This was one of two specimens obtained by the late Theodore Hohmann from the Pulacayo mine, Huanchaca, Bolivia. It was found that the angular measurements, the presence of copper, the colour, lustre, hardness, crystal habit and the perfect cleavage

[1] See this volume, p. 188.

[2] Stibnite occurs at Güejar-Sierra, according to P. Sampayo and A. A. de Linera. —*Revista Minera, Madrid*, VIII, 274, 1857.

observed for these crystals agreed equally well with the descriptions of both chalcostibite and guejarite. Owing, however, to the small amount of material, a quantitative analysis could not be made; this has now been done by Frenzel, and his results, given in Column VI above, agree closely with the formula $Cu_2S.Sb_2S_3$.

Both of the Bolivian specimens consist of a matrix of pyrites, quartz and tetrahedrite. That examined by Penfield shows numerous bright, prismatic crystals, averaging 1 mm. in diameter and 2 mm. in length, which are highly modified and rich in terminal faces. On these crystals he observed 20 forms, 13 of which are new; and, from the very good angles $863 : \bar{8}63 = 126°21'$ and $863 : \bar{8}6\bar{3} = 138°21'$, calculates $a : b : c = 0{\cdot}5312 : 1 : 0{\cdot}63955$. The observations made on the British Museum specimen, which are incorporated in the present paper, were less complete, as here the crystals were smaller and terminal faces were rare; on these blade-shaped crystals the following forms were observed: $c\eta idg\alpha\beta\gamma\delta\varepsilon$, the last five being new.

In the present paper, tables of angles measured by Penfield, C. Friedel, H. Laspeyres, G. G. Schott (on a crystal in the Munich collection) and L. J. Spencer are given; many of these vary from the calculated values owing to the striated character of some of the faces, but others are very close. Pyramids with complicated indices seem to be rather characteristic for chalcostibite, the forms $q\{863\}$ and $p\{6.12.7\}$ occurring on the Wolfsberg as well as on the Bolivian crystals. In the following table the forms observed by various authors are brought together. Here Laspeyres' $p\{7.14.8\}$ and $r\{7.21.27\}$ are given as $p\{6.12.7\}$ and $r\{134\}$ respectively.

b {010}	Δ_3 {205}	g {201}	p {6.12.7}	σ {4.12.5}
c {001}	e {307}	f {011}	μ {136}	τ {261}
l {130}	j {102}	s {065}	r {134}	α {233}
Δ {209}	h {203}	t {021}	ν {133}	β {354}
Δ_1 {207}	d {101}	u {061}	π {265}	γ {474}
Δ_2 {103}	i {302}	q {863}	ρ {263}	δ {475}
				ε {476}

L. J. S.

Edingtonite from Sweden. This rare zeolite, previously only known as small crystals from Old Kilpatrick, in Dumbartonshire, was determined by Haidinger in 1825 to be tetragonal with sphenoidal hemihedrism, and $a : c = 1 : 0{\cdot}6725$. The original analysis by Turner was incorrect, and that published by Heddle in 1855 gave the formula as being probably

$BaO.Al_2O_3.3SiO_2.3H_2O$. The same mineral has recently been found in large crystals at the manganese mines of Böhlet in Vestergötland.

Otto Nordenskiöld (*Geol. Fören. i Stockholm Förh.* XXVII, 597-600, 1895; and *Bull. Soc. fran. Min.*, XXVIII, 396, 1895) has found these new crystals to be orthorhombic and hemihedral. The forms present are {001}, {110}, {111}, {1$\bar{1}$1}, {121} and {12$\bar{1}$}; the complimentary forms {$\bar{1}$21} and {1$\bar{2}$1} are not found on the same crystal. The measured angles agree closely with Haidinger's determinations, as may be seen from the axial ratios; they are also close to those of natrolite and scolecite.

Edingtonite, $a : b : c = 0{\cdot}9872 : 1 : 0{\cdot}6733$
Natrolite, $a : b : 2c = 0{\cdot}9785 : 1 : 0{\cdot}7072$
Scolecite, $a : b : 2c = 0{\cdot}9763 : 1 : 0{\cdot}6868$; $\beta = 89°18'$

The habit of the crystals in being prismatic differs from that of the Scotch mineral. There is a perfect prismatic cleavage ($mm' = 89°16'$), and one less perfect parallel to the basal plane. Detailed optical determinations are given in the paper. The plane of the optic axes is (010), and the acute negative bisectrix is parallel to the c' axis. For sodium light, $2E_a = 87°17'$, $2V = 52°55'$, $\alpha = 1{\cdot}5370, 1{\cdot}5395$, $\beta = 1{\cdot}5492$, $\gamma = 1{\cdot}5540$.

G. Lindström (*Öfvers. Vetensk.-Akad. Förh. Stockholm*, LIII, 469-472, 1896) gives an analysis (I) which proves the identity of these crystals with the Scotch edingtonite.

	SiO_2.	Al_2O_3.	Fe_2O_3.	BaO.	CaO.	MnO,MgO.	Na_2O.	K_2O.	H_2O.	Cl.	Total.
I.	36·37	20·06	0·04	29·99	0·16	0·06	0·20	0·21	13·12	trace	100·21
II.	36·98	22·63	—	26·84	trace	—	trace	—	12·46	—	98·91

The molecular ratios $Al_2O_3 : BaO(CaO, alkalies) : SiO_2 : H_2O = 1 : 1 : 3 : 3{\cdot}7$, agree with those of Heddle's analysis (II) with the exception of the water. At 100° there is a loss of 3·82 per cent. water. Sp. gr = 2·782 (Lindström), 2·776 (Nordenskiöld).

A. Lacroix (*Bull. Soc. fran. Min.*, XIX, 422-426, 1896) attributes the uniaxial character of the Scotch edingtonite, as observed by Mallard and himself, to twinning about the pseudo-tetragonal axis; he shows that something of the same sort is exhibited by natrolite. L. J. S.

Asbestos and Asbestiform Minerals, (G. P. Merrill, *Proc. U. S. National Museum*, XVIII, (1895), 281-292, 1896).—As commercially used the name asbestos now covers at least four distinct minerals which have in

common only a fibrous structure and more or less fire- and acid-proof properties; these are:—

1. Tremolite or asbestos proper.
2. Serpentine (amianthus).
3. Anthophyllite.
4. Crocidolite.

The first two are as a rule readily distinguished by the silky fibres and greater flexibility of asbestiform serpentine; but tremolite and anthophyllite can only be distinguished by optical (extinction angle) and chemical means, and it is here shown that much of what is labelled in collections as asbestos is really anthophyllite.

The fibrous structure of these minerals is, in many cases, secondary, and due to a process of shearing; the original mineral, an amphibole and probably sometimes a pyroxene, being drawn out in the direction of the vertical axis, giving rise to fibres bounded by the prism cleavages of amphibole. Cases are cited of asbestos coating the surfaces of slickensides. L. J. S.

Thaumasite from West Paterson, New Jersey. (S. L. Penfield and J. H. Pratt, *Amer. Journ. Sci.*, I, 229-233, 1896; and *Zeits. Kryst. Min.*, XXVI, 262, 1896). Owing to the anomalous composition of thaumasite, which has previously only been known from Sweden, its occurrence at a new locality is of interest. At Paterson, New Jersey, it has been found in considerable quantity with zeolites in a trap rock. It here consists of an aggregate of prismatic crystals, sometimes loose, but more often firm, and resembling white alabaster in appearance. There is a distinct prismatic cleavage with angles of about 60°; the mineral is optically uniaxial and negative; the crystalline system is therefore hexagonal. Sp. gr 1·875—1·887.

Analysis I gives the usual formula $CaSiO_3.CaCO_3.CaSO_4.15H_2O$. At 150°, $13H_2O$ is expelled, and the remainder goes off at four higher temperatures; the structural formula is therefore written as—

$$[(CaOH)CO_2]\,[(CaOH)SO_3]\,[CaOH]\,HSiO_4+13H_2O.$$

The alkalies are present as impurities, since they are dissolved out, together with a little thaumasite, by water.

	SiO_2.	CO_2.	SO_3.	CaO.	H_2O.	Na_2O.	K_2O.	Al_2O_3, Fe_2O_3.	Total.
I.	9·26	6·82	13·44	27·13	42·77	0·39	0·18	—	99·99
II.	8·95	8·25	12·60	27·30	43·70	—	—	0·30	101·10

F. Pisani (*Bull. Soc. fran. Min.*, XIX, 85-87, 1896) gives analysis II, of the material from this locality; he gives the chemical formula as $2CaO.(SiO_2,CO_2)+CaO.SO_3+16H_2O$, and the system as being possibly monosymmetric. L. J. S.

Dehydration of Stilbite. (F. Rinne, *Neues Jahrb. Min.*, I, 41-60, 1897). When stilbite ($CaAl_2Si_6O_{16}+6H_2O$) is placed in concentrated sulphuric acid, the loss of water is accompanied by a progressive change in the optical characters of the crystals; the optic axes vary their positions, passing through uniaxial positions four times. These changes, which also take place when the crystals are heated, are gradual, but the following stages can be distinguished:—

Temperature.	$CaAl_2Si_6O_{16}+$	Uniaxial on	System.
125°	$5H_2O$	$(\bar{2}01)$	Monosymmetric
150°	$4H_2O$	(010)	,,
185°	$3H_2O$	(001)	,,
250°	$2H_2O$	$(\bar{2}01)$	Passage to orthorhombic
350°	H_2O	—	Orthorhombic
Ignition	—	—	Amorphous

The name *metadesmine* is given to these dehydrated forms. These changes are analogous to those which take place in heulandite. By the action of dilute acids, birefringent forms of silica are produced as in heulandite (this vol. p. 243). L. J. S.

Rœblingite. (S. L. Penfield and H. W. Foote, *Amer. Journ. Sci.*, III, 413-415, 1897). This new mineral is of interest in being the first sulphite that has been observed in nature. It occurs as white, compact masses filling cavities in axinite, which forms veins in the garnet rock of the zinc deposits of Franklin, New Jersey. The associated minerals are sphene, zircon, phlogopite, willemite, datolite, barytes, caswellite, calcite, mispickel, blende, rhodonite and rhodochrosite. Under the microscope, rœblingite is seen to consist of an aggregate of minute prismatic crystals with straight extinction and weak birefringence. The hardness is a little below 3; sp. gr. 3·433. The powdered mineral is

easily soluble in dilute acids with separation of gelatinous silica and evolution of sulphur dioxide. The mean of two analyses by Foote is :—

SiO_2.	SO_2.	PbO.	MnO.	CaO.	SrO.	K_2O.	Na_2O.	H_2O.	Total.
23·58	9·00	31·03	2·48	25·95	1·40	0·13	0·40	6·35	100·32

The formula is given somewhat doubtfully as—

$$H_{10}Ca_7Pb_2Si_5S_2O_{28} = 5H_2CaSiO_4 + 2(CaO.PbSO_3).$$

It is not probable that the mineral is a mixture, or contains much impurity. L. J. S.

Pseudogaylussite from Holland (F. J. P. van Calker, *Zeits. Kryst. Min.*, XXVIII, 556-572, 1897).—Spheroidal groups of crystals, closely resembling the well-known pseudomorphs from Sangerhausen in Thuringia and other localities, have been found embedded in alluvial clay at Onderdendam, in the province Groningen. The acute pyramidal crystals are of a yellowish colour, and the surfaces are rough and curved. In the interior they consist of a cellular aggregate of differently orientated calcite grains; analysis shows the presence of 89·9462 per cent. of calcium carbonate. Pseudogaylussite is also recorded from Kwadyk and Friesland, in Holland.

A review is given of the literature of these pseudomorphs, and the evidence supplied by the chemical composition and external form is discussed. No definite conclusion is arrived at as to what was the original mineral, which has been variously assumed to be gaylussite (Breithaupt, 1836), celestite (Des Cloizeaux, 1843; compare Miers, this volume, p. 264), gypsum (Kenngott 1870), anhydrite (Groth, 1878), and a hypothetical tetragonal chloro-carbonate of calcium (Dana, 1884). The author has failed to detect strontium by spectroscopic methods; and the presence of a little sodium carbonate, and the porous structure of the pseudomorphs, seem to suggest that gaylussite was the original mineral. Several angles have been measured, but owing to the roughness and curvature of the faces the variations are considerable, amounting to 10° or even 20°. From the comparison of these angles with the angles between the gaylussite forms {011} and {$\bar{1}$12} and the celestite forms {133} and {144} no conclusions can be drawn. L. J. S.

NOTES AND COMMENTS.

THIS year has seen the close of the careers of two eminent Mineralogists. Alfred L. O. L. Des Cloizeaux, who had been since 1876 Professor of Mineralogy at the Museum of Natural History in Paris, and Gustav A. Kenngott, who was for nearly 40 years Professor of Mineralogy at Zürich.

In Professor Des Cloizeaux the Mineralogical Society loses one of its most distinguished Corresponding Members.

Another Corresponding Member has been taken from the Society in the person of Professor J. J. S. Steenstrup, of Kopenhagen, who died at the advanced age of 84.

Death has also robbed us of one of our Vice-Presidents, Dr. Samuel Haughton, who was Professor of Geology at Trinity College, Dublin, from 1851 to 1881.

Even more recently we hear with great regret of the death of Dr. M. F. Heddle, a Past-President of the Society, and one of its founders and most active members. He died on Nov. 19th.

Some notice of the life and work of Des Cloizeaux and Heddle will be given in the next number.

We regret also to record the death on May 25th, at the age of 75, of Dr. Lars J. Igelström, an indefatigable mineralogist, who added the names of many new species to the science.

Also of Samuel Allport, well known as one of the pioneers of microscopical petrology, who died on the 7th of July, aged 81.

Among recent appointments are the following:—Dr. Beckenkamp becomes Professor of Mineralogy at Würzburg, and is succeeded at Mülhausen by Dr. Osann, of Heidelberg; Professor A. J. Moses is appointed to the Chair of Mineralogy in Columbia College; and Mr. C. H. Warren becomes Instructor in Mineralogy in the Sheffield Scientific School of Yale University; Professor A. de Lapparent has been elected a Member of the Paris Academy of Sciences in succession to the late Professor Des Cloizeaux.

OBITUARIES.

Gustav Adolf Kenngott.

THE following particulars of the life and work of this well-known mineralogist are mainly derived from an obituary notice by U. Grubenmann, in the *Vierteljahrsschrift d. Naturforschenden Gesellschaft in Zürich*, XLII. pp. 74-9:—

Gustav Adolf Kenngott was born on January 6th, 1818, at Breslau. In the university of his native town he studied mathematics and natural science, and in 1844 became Privatdocent for Mineralogy, Crystallography and Geognosy. In 1850 he removed to Vienna, and in the winter of that year obtained the Professorship in Natural Science in the Oberrealschule at Pressburg. In 1852 he returned to Vienna as Custos-Adjunkt in the Hofmineralienkabinett, which position he held until 1856, when he was elected Professor of Mineralogy in the Polytechnic School in Zürich, and a year later obtained the ordinary Professorship in the University. These posts he held until his retirement in 1893. What use Kenngott made of time and opportunity in the interests of his tutorial work, in order to further the advance of mineralogy, may be judged from the list of his published works, which occupies seven pages appended to his obituary notice.

He was the author of various text-books on crystallography, mineralogy and petrology, while his book, *Die Minerale der Schweiz*, Leipzig, 1866, remains the standard work of reference for Swiss minerals. His first published papers relate chiefly to crystallography, but his subsequent contributions to mineralogy are for the most part devoted to the description of the character of particular mineral species. From his papers and his method of teaching it is clear that throughout his career Kenngott directed his efforts rather to accurate observation and grasp of detail than to the pursuit of brilliant generalisations. He died on March 14th, 1897.

Samuel Haughton, M.D., F.R.S.

Samuel Haughton was born December 21st, 1823, at Carlow, in which town his father owned extensive flour mills.

He entered Trinity College, Dublin, and in 1843 was first Senior Moderator in Mathematics. He obtained his Fellowship in the following year, at the very early age of 21. He at once took Orders, as at that date two only of the Fellows could be laymen. At first he devoted himself to

Molecular Mechanics, and in 1848 received the Cunningham Medal of the Royal Irish Academy for his *Memoir on the Equilibrium and Motion of Solid and Fluid Bodies*. He also worked much on Tidal questions.

In 1851 the Professorship of Geology in the University fell vacant, owing to the appointment of Oldham to the Superintendentship of the Indian Geological Survey.

Haughton took the post, which thus connected him with the then rising Engineering School. At this time began his long and intimate connection with Professor Galbraith, another of the staff of that School. The two Professors brought out together a series of Manuals of Science, which had a great popularity. The two also threw themselves with great zeal into the Military Classes, in preparation for the Commissions at Woolwich, thrown open at the time of the Crimean War.

In 1854 Haughton took up Chemistry, and that led on to Medicine, and he became Registrar of the Medical School. This Journal, however, is hardly the place in which to deal with his researches into Animal Mechanics.

He held his Geological Professorship for 30 years, till 1881, when he became a Senior Fellow.

In his Geological work he principally dealt with Chemical Petrology. His analyses, however, were not minutely exact; in his analyses of felspars he often estimated all the alkalies together, and then proceeded to treat the results mathematically, as if all the data were rigorously correct. The outcome of this was that his conclusions were somewhat sharply criticised.

His papers on the Granites of Donegal are the best examples of his methods of calculating rock constituents.

The number of his papers down to 1884 in the Royal Society Catalogue is no less than 173.

He was elected F.R.S. in 1858; he received Honorary Degrees, not only from home, but also from foreign Universities. He was an original Member of the Mineralogical Society, and one of its Vice-Presidents from its institution in 1876 to the present year.

His death occurred on October 31st, 1897.

He married his first cousin, who predeceased him, and left three sons and one daughter.

Dr. Haughton leaves behind him the memory of one of the warmest of friends; of him also it might almost be said that in Science at least *Nihil tetigit quod non ornavit.* R. H. S.

INDEX TO VOL. XI.

(See also "List of New Mineral Names," p. 323, and list of "British Pseudomorphs," p. 279.)

Absorption brushes in epidote, 97.
Adams (F. D.)—Nepheline-syenite, Ontario, 46.
———— and Harrington (B. J.)—Hastingsite, 244.
Ægirite, Greenland, 101.
Albite, cleavage and parting planes, 43.
Aleksyeev (V.)—Alexjejewite, 236.
Alexjejewite, 236.
Allport (S.)—Death of, 345.
Alnö (Sweden), nepheline-syenite, etc., 250.
Alnöite, 251.
Alston "satin spar," 184.
Altaite, Burma, 215.
Aluminium phosphates, 4, 16, 226, 332, 336.
Alumino-silicates, constitution of, 111.
Alunite, Bolivia, 298.
Amianthus, 342.
Amphibole, soda-, 35, 244.
Amphibolites, Piedmont, 260.
Analcite, constitution of, 38.
———— in monchiquites, 262.
———— group of rocks, 262.
Anatase in rocks, 262.
Andorite, 286.
Andradite, titaniferous, Ontario, 244.
Anhydrite, artificial, 45.
Anglesey, basic ferric sulphate, 13.
Anglesite, cryst., 197.
Anorthoclase, Massachusetts, 252.
———— Vulcano, 35.
———— -augite rock, Vulcano, 35.
Anthophyllite, asbestiform, 342.
————, Bengal, 118.
Apatite in peridotites, Bengal, 117.
Aplite, xenotime, &c., in, 306.
Apophyllite, constitution, 38.
———, S. Africa, 318.
Aragonite and calcite, massive, 184, 165.
Argyrodite, Bolivia, 40.
Artificial anhydrite, 45.
———— boleite, cumengeite and percylite, 164.
———— powellite, 164.
———— silica, 243, 343.
Arzruni (A.) and Thaddéeff (K.)—Celestite, 234.
Asbestiform minerals, 341.
Asterism in corundum, 52.
Augelite, Bolivia, 16.
Augite, Vulcano, 35.

Bäckström (H.)—Leucite rocks in the Lipari Is., 255.
Baddeleyite, Brazil, 110, 39.
Bagotite, 323.
Ball (V.)—Obituary, 92.
Barlow (W.) — Homogeneous structures and the symmetrical partitioning of them, 119.
———— Homogeneous structures and circular polarisation, xvi.
Barytocelestite, 235.
Basalt, Montana, 253.
Bauer (M.)—Edelsteinkunde, 220, 92.
——— Jadeite, Burma, 160.

Bauer (M.) Jadeite, "Tibet," 241.
Baumhauer (H.)—Rathite, 225.
Beckenkamp (J.)—345.
Berkeley (Earl of)—Determination of density, 64.
Bertrandite, Bohemia, 106.
Beryl, Bohemia, 106.
Berzeliite, chem., 10.
Binnenthal, rathite, 225.
Binnite, 77.
Biotite, altered, 243.
——— -kyanite-cordierite rock, 141.
Bleinierite after zinckenite, 23.
Blödite, Punjab, 314.
Blue ground, S. Africa, 321.
Boleite, artificial, 164.
———, N. S. Wales, 165.
Bolivia, 16, 40, 298, 339.
Bonney (T. G.)—Cone-in-cone structure, 24.
Bostonite, 247, 249.
Bournonite, cryst., 228.
———— Bolivia, 22.
Box-stones, 43.
Brauns (R.)—91.
——— artificial anhydrite, 45.
Brazil, 80, 176, 302.
Breithauptite, cryst., 107.
British Mineralogical Society, 184.
——— Museum, Introduction to the Study of Rocks, 148.
——— pseudomorphs, 263.
Brögger (W. C.)—Dyke rocks near Christiania, 114.
——— Triassic eruptive rocks of S. Tyrol, 155.
Broken Hill, N. S. W., 165, 236.
Brown (A. P.)—Pyrites and marcasite, 105.
Brown (C. B.) & Judd (J. W.)—Rubies of Burma, 232.
Brush (G. J.) — Determinative mineralogy, 219.
Bücking (H.)—Sulfoborite, 103.
Building materials in the Vienna Museum, 34.
Burma, 160, 215, 232.
Busz (K.)—146.
Busz (K.)—Breithauptite, 107.
———— Caledonite, 108.
———— Kamarezite, 108.
———— Pyrrhotite, 109.
———— Picrite, Devon, 154.

Cacoxenite, chem., 8.
Calaverite, Colorado, 235.
Calcite, etching, 242.
——— and aragonite, massive, 184, 165.
——— primary in eruptive rocks, 250.
Caledonite, Leadhills, cryst., 108.
Calker (F. J. P. van)—Pseudogaylussite, 344.
Canfieldite, 40.
Caryinite, chem., 162.
Cassiterite, cryst., 107; Bolivia, 299.
Caswellite, 243.
Cataforite, 115, 250.
Catapleiite, Greenland, 101.
Celebes, leucite rocks, 36.
Celestite, cryst., 234.
Cerussite coated with galena, 235.
Cesàro (G.)—Valleite, 228.
Chabazite, constitution, 37.
Chalcanthite, Bolivia, 23.
Chalcophanite, 44.
Chalcostibite, cryst., 188.
———————— Bolivia, Spain, 338.
Chemical crystallography (Fock), 95.
Chester (A. H.)—Caswellite, 243.
Chili, 104, 240.
Chondrodite, cryst., 138.
Christiania, rocks, 114, 156, 250.
Chromite deposits, 112.
Chrustchoff (K. von)—32.
Church (A. H.)—Chemical study of arsenates and phosphates, 1.
———————— Basic ferric sulphate from Anglesey, 13.
———————— Determination of density, v.
Cinnabar gravels of Tripuhy, 179.
Clarite = enargite, 75.
Clarke (F. W.)—Constitution of zeolites, 37.
———— ———— Garnet, 235.
Clinoclase, chem., 4.

Clinohumite, cryst., 138.
Clinozoisite, 237.
Cole (G. A. J.)—Hullite, 229.
Concretions in sandstone, 42.
Cone-in-cone structure, 24.
Constitution of zeolites, 37.
Cooksey (T.)—Opal from N. S. Wales, 244.
Cordierite rock, Himalayas, 141.
Corrosion of minerals in magmas, 145.
Corundum, alteration, 52, 233.
——— structure planes, 49.
——— Burma, 232.
——— -rocks, India, 57.
Crocidolite, asbestiform, 342.
Crossite, 35.
Cryptopyramid, 98.
Crystal angles, variation of, in celestite, 234.
——— structure, 119, xvi.
——— systems, 150.
Crystallography, chemical, 95.
——— ——— for beginners (Woodward), 222.
Crystals, Morphology of (Maskelyne), 93.
Cubic system, structure, 120.
Cumengeite, artificial, 164.

Dana (J. D.)—Obituary of, 89.
Darapskite, cryst., 104.
Darling (C.)—Analysis of mica, 209.
Daubrée (G. A.)—Obituary of, 146.
Davison (J. M.)—Wardite, 226.
Delessite, Cantyre, 28.
Density, determination of, v., 64, 186.
Derby (O. A.)—Monazite and xenotime in rocks, 304.
Derbylite, 176, 85.
Des Cloizeaux (A.)—Death of, 345.
Determinative mineralogy, 219.
Diamond in garnet, xvii.
——— phosphorescent, 241.
Dietzeite, cryst., 104.
Differentiation in magmas, 38, 112, 114, 251.
Diopside, chrome-, Montana, 253.
Double salts, 300.
Dudgeon (P.)—Mispickel form Kirkcudbright, 15.
——— Obituary of, 30.
Dune sands of Holland, 113.
Dungannon (Ontario), 46, 244.
Dyke-rocks, Christiania, 114.

Eakle (A. S.) and Muthmann (W.)—Schneebergite, 229.
Edingtonite, Sweden, xi. 340.
Elæolite-syenite, Ontario, 46, 244; Monchique, 246; Alnö, 250; Texas, 248.
Enargite, cryst., 69, 196.
Enclosures in crystals, xvi. xvii. 41, 199, 233, 296.
English (G. L.)–Catalogue of minerals, 33.
Enstatite and humite, 139.
Epididymite, 100.
Epidote, optics, 97, 245.
——— and zoisite, 237.
Epistilbite, constitution, 37.
Etching, augelite, 19; calcite, 242; corundum, 53.
Euchroite, chem., 1.
Euphyllite, India, 58.

Famatinite, 77.
Faujasite, constitution, 37.
Fayalite, opt., 240.
Felsite-porphyry, New Brunswick, 253.
Fernando Noronha, monchiquite, 171.
Ferric sulphate, basic, Anglesey, 13.
Fibrolite-rock, India, 60.
Fletcher (L.)—Introduction to the study of rocks, 148.
Flink (G.)—New minerals from Greenland, 100.
Fluor-adelite, 229.
Fluorine and hydroxyl in minerals, 41.
Fock (A.)—Chemical crystallography, 95.
Foote (A. E.)—Death of, 146.
Foote (H. W.) and Penfield (S. L.)—Rœblingite, 343.
Foote (W. M.)—Northupite, 159.
Forbes (E. H.)—Epidote, 245.

Forbes (E. H.) and Penfield (S. L.)—Olivine group, 239.
Foresite, constitution, 37.
Foster (C. le N.)—Diamond in garnet, xvii.
Foullon (H. v.)—Obituary, 217.
France, mineralogy of, 218.
Franckeite, 41.
Frenzel (A.) and Penfield (S. L.)—Identity of chalcostibite and guejarite, 338.
Friedel (C.)—Artificial cumengeite, boleite and percylite, 164.
Fuchsite, India, 58.
Futterer (K.)—91.

Gabbro, metamorphosed, Zermatt, 256.
Gadolin (A.)—Crystal systems, 150.
Garnet group, 238.
——— simulating jade, 235.
——— -rock, N. S. Wales, 63.
Gismondite, constitution, 37.
Glaucophane-eclogite, Zermatt, 257.
Glencullen (Co. Wicklow), mica, 209.
Glockerite, chem., 14.
Gmelinite, constitution, 37.
Gneiss, monazite, etc., in, 304.
Gold, Burma, 215.
—— in granite, 227.
—— moss-, 101.
—— origin of nuggets, 101.
—— hexagonal forms, 102.
—— moiré-métallique, 103.
—— condition in veins, 101.
Granite, monazite, etc., in, 307; gold in, 227.
Green (A. H.)—Obituary, 147.
Greenland, minerals, 100.
Grorudite, 115, 249.
Groth (P.)—Gadolin's crystal systems, 150.
Guejarite = chalcostibite, 338.
———— Bolivia, 23.
Gypsum and anhydrite, artificial, 45.
——— with fluid enclosures, Sicily, 44.
Hackman (V.) and Kraatz-Koschlau (K. v.)—Elæolite-syenite, 246.
Hæmatite, cryst., Brazil, 85.
——— pseudomorphs, 269.
Hamberg (A.)—Etching of calcite, 242.
Hanksite, chem., 227.
Harrington (B. J.) and Adams (F. D.)—Hastingsite, 244.
Harrison (W. J., Junr.)—Prehnite in Wales, 198.
Hartley (W. N.)—Analysis of mica, 210.
Hastingsite, 244.
Haughton (S.)—Obituary of, 346.
Haushofer (C. v.)—Death of, 32.
Hautefeuillite, 162.
Heavy fluids for the separation of minerals, 44, 114, 228.
Heddle (M. F.) Death of, 345.
———— and Thomson (J. S.)—Delessite from Cantyre, 28.
Henderson (J. A. L.)—Apophyllite in S. Africa, 318.
Henderson (J. M. C.)—Mica-syenite in Saxony, 259.
Herderite, chem., 42.
Herschel (A. S.)—Crystal models, ix.
Herz (W.)—Salvadorite, 240.
Heteromorphite, 195.
Heulandite, action of acids on, 243.
———— constitution, 37.
Hidden (W. E)—Peridote in pyrope, &c., xvi.
Highwood Mtns. (Montana), 151,
Hillebrand (W. F.)—Calaverite, 235.
Hintze (C.)—Handbuch der Mineralogie, 217.
Hobbs (W. H.)—Volcanite, 35.
———— Cerussite, 235.
Hoeferite, 161.
Hoffmann (G. C.)—Native iron from Ontario, 160.
Högbom (A. G.)—Nepheline-syenite from Alnö, 250.
Holland, 113, 344.
Holland (T. H.)—Mica-hypersthene-hornblende-peridotite, from Bengal, 117.
Holland (T. H.)—Phosphatic mica-peridotites from Bengal, 117.

Holmquist (P. J.)—Knopite, 158.
——————— Pyrochlore, 231.
Homogeneous structures, 119.
Hornblende, Montana, 254.
——————- alkali, 35, 244.
Hortonolite, opt., 240.
Howe (W. T. H.) and Penfield (S. L.) —Chondrodite, etc., 161.
Hullite, 229.
Humite series, 137, 161.
———- Zermatt, 258.
Hussak (E.)—Baddeleyite from Brazil, 110.
——————— Perofskite-magnetic-rock, 117.
——————— & Prior (G. T.)—Lewisite and zirkelite, 80.
——————————————— Derbylite, 176.
——————————————— Tripuhyite, 302.
Hutchinson (A.)—Pyrites from Cornwall, xv.
——————————— Calcite from Cleator Moor, xvi.
——————————— Epidote from the Mourne Mtns., xvii.
Hydrofranklinite = chalcophanite, 44.
Hydronephelite, 37, 112.
Hydroxyl and fluorine in minerals, 41.

Idocrase, chem., 230.
Igelström (L. J.)—Lindesite & pyrrho arsenite, 105. Death of, 345.
Igneous rock masses, form of, 156.
Ijolite, 47.
Ilmenite-norite, Norway, 38.
Iron, native, Ontario, 160.

Jablonowskische Gesellschaft, prize, 146.
Jacupirangite, 86, 110, 117.
Jadeite, Burma, 160.
——————— "Tibet," 241.
——————— -plagioclase-nephelite rock, 242.
Jarrowite, 264, 328.
Johnstrup (F.)—Obituary, 32.
Judd (J. W.)—Structure planes of corundum, 49.
——————————— Simple massive minerals, 56.
——————————— and Brown (C. B.)—Rubies of Burma, 232.

Kaliophilite, 111.
Kamarezite, 108.
Kaolin, xenotime, etc., in, 301.
Karrer (F.)—Building materials in the Vienna Museum, 34.
Katzer (F.)—Hoeferite, 161.
Kauaiite, 166.
Kenngott (G. A.)—Obituary, 346.
Keratophyres in U. S. A., 252.
Klinozoisite, 237.
Knistersalz, 234.
Knopite, 158.
Knoblauch (H.)—Death of, 91.
Koblmann (W.)—Cassiterite, 107.
Koken (—)—91.
Kraatz-Koschlau (K. v.) and Hackman (V.)—Elæolite-syenite, 246.
Kreider (D. A.) and Penfield (S. L.)—Identity of hydrofranklinite and chalcophanite; heavy fluid for separating minerals, 44.
Krenner (J. A.)—Lorandite, 32, 168.
Kühnite, chem., 10.
Kunz (G. F.)—Phosphorescent diamonds, 241.
Kyanite, cryst., Brazil, 84.
——————— Himalayas, 142.

Laccolites, 156, 151.
Lacroix (A.)—Min. of France, 218.
——————- Edingtonite and natrolite, 341.
Lamprophyre, Montana, 255.
Lapparent (A. de)—345.
Laumontite, constitution, 37.
Laurion (Greece), 43, 106, 108.
Lautarite, cryst., 104.
Lautite, 78.
Lawson (A. C.)—Basic orthoclase rock, 153.
Lawsonite, 157.
Leadhillite, Missouri, 103.

Leucite, constitution, 38.
——— -rocks, 36, 255, 262.
Levynite, constitution, 37.
Lewis (W. J.)—Humite series, 137.
Lewisite, 80, 179.
Limestone of igneous origin, 250.
Lindesite, 105, 168.
Lindöite, 116.
Lindström (G.)—Edingtonite from Sweden, 341.
Lipari Is., rocks, 35, 255.
Liparite, Texas, 249.
Liroconite, chem., 3.
Litchfieldite, 47.
Lithical characters, 148.
Lithiophilite and triphylite, 158.
Liversidge (A.)—Gold, 101.
——————— Boleite from N. S. Wales, 165.
——————— Marshite, 236.
Lorandite, 32, 168.
Lossenite, 106.
Louis (H.)—Altaite from Burma, 215.
Luzonite, 77.

Machacamarca, Bolivia, 22.
McMahon (C. A.) — Biotite-kyanite-cordierite rock, 141.
Magmatic differentiation, 38, 112, 114, 251.
Malignite, 153.
Mallet (F. R.)—Nemalite, 211.
——————————— Blödite, 314.
Marbles, 165, 187.
Marcasite and pyrites, constitution, 105.
Marsh (C. W.)—Marshite, 236.
Marshite, 236.
Martite, Brazil, 85.
Maskelyne (N. S.)—146.
——————————— Morphology of crystals, 93.
Massachusetts, rocks, 252.
Massive minerals, 56.
Matthew (W. D.) — Lavas of New Brunswick, 253.
Mauzeliite, 229, 82.
Melaconite, Bolivia, 23.
Merrill (G. P.)–Sandstone concretions, 42.
——————— Onyx marbles, 165.
——————— Gold in granite, 227.
——————— Rocks of Montana, 253.
——————— Asbestiform minerals, 341.
Metadesmine, 343.
Metamorphism of rocks, 247, 251, 256, 259.
Mica, Co. Dublin, 199.
——— -peridotites, Bengal, 117.
——— -syenite, Saxony, 259.
Michel (L.)—Hautefeuillite, 162.
——————— Artificial powellite, 164.
Miers (H. A.)—12, 146, 236.
——————— Cleveite and helium, vi.
——————— Obituary of J. D. Dana, 89.
——————— Indexing mineralogical literature, xvii.
——————— Simple names for the 32 types of crystal symmetry, xvii.
——————— A horizontal goniometer, xvii.
——————— British pseudomorphs, 263.
Milch (L.)—Lossenite, 106.
Mineral chemistry, 149.
Minerals, new names, 323.
Mineralogy, determinative, 219.
——————— Hintze's Handbuch, 217.
——————— of France, 218.
Minor (J. C., Jun.) & Penfield (S. L.) —Topaz, 41.
Mispickel, Bolivia, 23.
——————— Kirkcudbright, 15.
Missourite, 262.
Monazite, cryst., Brazil, 83.
——————— in rocks, 304.
Monchiquite, 262; Fernando Noronha, 171; Monchique, 247.
Montana, rocks, 251, 253, 262.
Monzonites, Tyrol, 155.
Mordenite, 38.
Moses (A. J.)—345.
Moss-gold, origin, 101.
Mügge (O.)—146.

Muthmann (W.) and Eakle (A. S.)—Schneebergite, 229.
Muscovite, constitution, 111.
——— Co. Dublin, 199.

Natrolite, constitution, 37.
——— Wales, 198.
Navarro (L. F.)—Quirogaite, 241.
Nemalite, Afghanistan, 211.
Nephelite, constitution, 112.
——— in a crystalline schist, 242.
——— Ontario, 46.
——— -syenite. *See* Elæolite.
Neptunite, 100.
Neumann (F. E.)—Obituary, 92.
New mineral names, 323.
New rock names, *See* Rocks.
Nickel sulphide ores, 39.
Nies (F.)—Death of, 146.
Nordenskiöld (G.)—Death of, 91.
Nordenskiöld (O.)—Edingtonite from Sweden, 341.
Nordmarkite, 114, 115.
Northupite, 159, 226.
Notes and comments, 32, 91, 146, 217, 346.

Obituary, S. Allport, 349.
——— V. Ball, 92.
——— J. D. Dana, 89.
——— G. A. Daubrée, 146.
——— A. Des Cloizeaux, 345.
——— P. Dudgeon, 30.
——— A. E. Foote, 146.
——— H. v. Foullon, 217.
——— A. H. Green, 147.
——— S. Haughton, 347.
——— M. F. Heddle, 345.
——— L. J. Igelström, 345.
——— F. Johnstrup, 32.
——— G. A. Kenngott, 346.
——— H. Knoblauch, 91.
——— F. E. Neumann, 92.
——— F. Nies, 146.
——— G. Nordenskiöld, 91.
——— J. W. Retgers, 217.
——— F. Sansoni, 91.
——— J. J. Steenstrup, 345.
Obituary, A. Streng, 217.
Oebbeke (K.)—91.
Offretite, 37.
Oligoclase, parting planes, 43.
Olivine and humite, 139.
——— group, chem., opt., 239.
Onyx marbles, 165, 187.
Opal, Australia, 244, iii.
Optical anomalies, topaz, 42; garnet, 239.
Ore deposits and magmatic differentiation, 38.
——— classification of, 112.
O'Reilly (J. P.)—Mica from Co. Dublin, 199.
Oriental alabaster, 165.
Osann (A.)—345. Chilian minerals, 104.
——— Elæolite-syenites, Texas, 248.
Osmiridium, occurrence, 39.

Paisanite, 249.
Palache (C.)—Crossite, 35.
Parting planes, felspar, 43.
——— corundum, 49.
Pearceite, 224.
Peck (F. B.)—Bournonite, 228.
Pegmatite, monazite, etc., in, 305.
Penfield (S. L.)—Canfieldite and argyrodite, 40.
——— Herderite, 42.
——— Penfieldite, 43.
——— ——— Cleavage and parting planes in oligoclase and albite, 43.
——— Brush's Determinative Mineralogy, 14th Edit., 219.
——— ——— Pearceite and polybasite, 224.
——— Calaverite, 236.
——— and Foote (H. W.)—Rœblingite, 343.
——— and Forbes (E. H.)—Olivine group, 239.
——— and Frenzel (A.)—Identity of chalcostibite and guejarite, 338.
——— and Howe (W. T. H.)—Chondrodite, etc., 161.

Penfield (S. L.) and Kreider (D. A.)—Identity of hydrofranklinite and chalcophanite; heavy fluids for separating minerals, 44.
——————— and Minor (J. C., Junr.)—Topaz, 41.
——————— and Pratt (J. H.)—Lithiophilite and triphylite, 158.
——————— ——————
Thaumasite, 342,
Penfieldite, 43.
Percylite, artificial, 164.
Peridotites, ores in, 112; Bengal, 117; Montana, 254; Piedmont, 260.
Perofskite-magnetite-rock, Brazil, 117.
Petrical characters, 148.
Petrology and mineralogy, 56.
Petterd (W. F.)—Catalogue of minerals of Tasmania, 218.
Pharmacolite, chem., 7.
Phenakite, Bohemia, 107.
Phillipsite, constitution, 37.
Phonolite, Texas, 248.
Phosgenite, artificial, 164.
Phosphatic peridotites, Bengal, 117.
Phosphorescent diamonds, 241.
Phyllites, metamorphism of, 259.
Picotite-rock, N. S. Wales, 63.
Pierite, Devon, 154.
——— hornblende-, Montana, 254.
Pipra (India), corundum, 57.
Pirsson (L. V.)—Monchiquite, 262.
——————— and Weed (W. H.)—Highwood Mtns., Montana, 151.
——————— ——————
Missourite, 262.
Pirssonite, 226.
Pisani (F.)—Thaumasite, 343.
Pisanite, 240.
Pisek (Bohemia), 106.
Pisolite, Carlsbad (Bohemia), 189.
Pittman (E. F.)—Willyamite, 236.
Plagionite, cryst., 192.
Platania (G.)—Xiphonite, 168.
Platinum, occurrence, 39.
Plumbo-resinite, pseudomorphs, 272.
Point systems, 119.
Polybasite, cryst., 224.
Pope (W. J.)—Chemical crystallography, 95.
——— ——— ——— Determining optic axial angles, x.
Porro (C.)—Peridotites, Piedmont, 260.
Potassium natrolite, 111.
Powellite, artificial, 164.
Pratt (J. H.)—Northupite, pirssonite, and hanksite, 226.
——————— and Penfield (S. L.)—Lithiophilite and triphylite, 158.
——— ——— ——— ——— ———
Thaumasite, 342.
Precious stones, 220.
Prehnite, Wales, 198.
Prior (G. T.)—Monchiquite from Fernando Noronha, 171.
——————— Composition of zirkelite, 180.
——————— and Hussak (E.)—Lewisite and zirkelite, 80.
——— ——————— Derbylite, 176.
——————————— Tripuhyite, 302.
——————— and Spencer (L. J.)—Augelite, 16.
——————— ——— ———
Identity of andorite, sundtite, and webnerite, 286.
Prolectite, 139, 161.
Pseudobrookite, Limoges, 305.
Pseudogaylussite, 344.
Pseudomorphs, 23, 112, 235, 344.
——— ——— British, 263.
Ptilolite, 38.
Pyknometer, 66.
Pyrites and marcasite, constitution, 105.
——— Bolivia, 23, 293.
——— Brazil, 85.
Pyroaurite, Sweden, 163.
Pyrochlore, Sweden, 231.
Pyroxenite, Montana, 254; Piedmont, 260; Tyrol 155.
Pyrrhoarsenite, 106.
Pyrrhotite, cryst, 109.
——— ——— nickeliferous, 39.

Quiroguite, 241.

Rammelsberg (C. F.)—Handbuch der Mineralchemie, 149.
Ransome (F. L.)—Lawsonite, 157.
Rathite, 225.
Refractive indices, determining in thin sections, 245.
Regnolite, 77.
Regular growth of enargite and barytes, 75.
Retgers (J. W.)—Dune-sands of Holland, 113.
——— Heavy fluids for separation of minerals, 228.
——— Obituary, 217.
Retzian, 166.
Rhyolites, ancient, from N. America, 252, 253.
Riebeckite, cryst., 231.
Rinne (F.)—Artificial silica, 243.
——— — Dehydration of stibnite, 343.
Robertson (Miss M. W.)—Analyses of mica, 200.
Rocks, Introduction to study of, 148.
——— monazite, xenotime, &c., in, 304.
——— simple, 56.
——— new names; Cataforite, 115; Lindöite, 116; Malignite, 153; Missourite, 262; Paisanite, 249; Shonkinite, 151; Sölvsbergite, 115; Stubachite, 116; Sussexite, 116; Volcanite, 35.
Rœblingite, 343.
Ruby, Burma, 232.
Rutile, cryst., Brazil, 85.
Rutley (F.)—Globular forms of chalybite from Cornwall, x.

Salvadorite, 240.
Sands, sea- and dune-, 113.
Sandstone concretions, 42.
Sansoni (F.)—Obituary, 91.
Satin spar, Alston, 184.
Saussurite-gabbro, Zermatt, 256.
Saxonite, Montana, 254
Schäfer (R. W.)—Metamorphosed gabbros, etc., Zermatt, 256.
Schiller structure in corundum, 52.
Schimpff (W.)—Sylvite, 233.
Schneebergite = garnet, 229.
Schorl-rock, India, 61.
Schulten (A. de)—Artificial northupite, etc., 226.
Scolecite, constitution, 37.
Sears (J.)—Ancient lavas in Massachusetts, 252.
Serpentine as an original igneous product, 116.
Separation of minerals by heavy fluids, 44, 113, 228, 304.
Shonkinite, 151.
Silica, artificial form of, 243, 343.
Silver-thallium nitrate, 44, 228.
Sjögren (H.)—Fluid enclosures in gypsum, 44.
——— ——— Prolectite, 161.
——— ——— Caryinite and soda-berzeliite, 162.
——— ——— Pyroaurite, 163.
——— ——— Retzian, 166.
——— ——— Urbanite, 167.
——— ——— Tilasite, 229.
——— ——— Mauzeliite, 229, 83.
Soda-anorthite, 111.
——— -berzeliite, 163.
——— -nepheline-hydrate, 111.
Sodalite, constitution, 111.
——— -syenite, Montana, 151, 255.
Sollas (W. J.)—Riebeckite, 231.
Solution planes in corundum, 53.
Sölvsbergite, 115.
Spencer (L. J.)—Enargite, 69.
——— Alston satin spar and massive calcites and aragonites, 184.
——— Zinckenite and wolfsbergite, 188.
——— ——— Plagionite, stephanite, enargite, anglesite, 192.
——— ——— Identity of guejarite and wolfsbergite, x. 338.
——— List of new minerals, 323.
——— & Prior (G. T.)—Augelite, 16.
——— ——— —— ——— Identity of andorite, sundtite and webnerite, 286.

Stalactitic marbles, 165, 187.
Steenstrup (J. J. S.)—Death of, 345.
Stephanite, cryst., 196.
Stilbite, constitution, 37.
—— – dehydration, 343.
Streng (A.)—91; Obituary, 217.
Structure planes of corundum, 49.
Structures, homogeneous, 119.
Stubachite, 116.
Sulfoborite, 103.
Sulphur, native, origin of, 45.
Sulphides, heavy fluids for separating, 228.
Sulphosalts, cryst., 225.
Sulphuretted hydrogen enclosed in gypsum, 44; in sylvite, 233.
Sundtite = andorite, 286.
Sussexite, 116.
Sylvite, Stassfurt, 233.
Syntagmatite, 244.

Talmage (J. E.)—32.
Tasmania, minerals of, 218.
Texas, nephelite rocks, 248.
Thaddéeff (K.) and Arzruni (A.)—Celestite, 234.
Thaumasite, New Jersey, 342.
Thomson (J. S.) and Heddle (M. F.)—Delessite from Cantyre, 28.
Thomsonite, constitution, 37.
Thugutt (S. J.) — Constitution of alumino-silicates, 111.
Tiffanyite, 241.
Tilasite, 229.
Tinguaite, Christiania, 116; Monchique, 247; Texas, 249.
Tolstopiatow (M.)—Recherches minéralogiques, 97.
Topaz, chem., opt., 41.
—— cryst, 99.
Tourmaline, Burma, 233.
———— -rock, India, 61.
Trachybasalts, Fernando Noronha, 172.
Triphylite and lithiophilite, 158.
Tripuhy (Brazil), 83, 176.
Tripuhyite, 302.
Tutton (A. E.)—Instrument for cutting crystal sections, vi.
Twin lamellæ in corundum, 53.
Tyrol, rocks, 155.
Tyrolite, chem., 5.

Urbanite, 167, 105.
Ussing (N. V.)—91.

Valleite, 228.
Vicinal faces, augelite, 17.
Vienna Museum, guide to building materials, 34.
Viola (C.)—Determination of refractive power in thin sections, 245.
Vogt (J. H. L.)—Ore deposits and magmatic differentiation, 38.
———————— Classification of ore deposits, 112.
Volcanite, 35.
Vrba (C.) – Beryl, etc., from Bohemia, 106.

Wardite, 226.
Warren (C. H.)—345.
Water enclosed in gypsum, 44.
——— of crystallisation, etc., 1, 46, 316.
Wax, mineral, Russia, 236.
Webnerite = andorite, 286.
Websterite, Montana, 254.
Weed (W. H.) and Pirsson (L. V.)—Highwood Mtns., Montana, 151; Missourite, 262.
Wehrlite, Montana, 254.
Weibull (M.)—Idocrase, 230.
Weidman (S.)—Ancient lavas in Wisconsin, 252.
Weinschenk (E.) — Serpentine-rocks, 116.
———————— Epidote and zoisite, 237.
———————— Garnet group, 238.
Wells (H. L.) – Leadhillite, 103.
Wichmann (A.)—Leucite rocks, Celebes, 36.
Willyamite, 236.
Wisconsin, ancient lavas, 252.
Wolfsbergite, cryst., 188.
———————— Bolivia, Spain, 338.
Woodward (C. J.) – Lecture-room apparatus for crystallography, x.
———————— Crystallography for beginners, 222.
Woodward (H. P.)—Geol. map of Western Australia, 32.

Xenotime, cryst., Brazil, 83.
———— in rocks, 304.
Xiphonite, 168.

Zeolites, constitution, 37.
Zermatt, rocks, 256.
Zinckenite group, 188.
———— Bolivia, 23.
———— Harz, 188.
Zircon, Brazil, 84.
——— in rocks, 304.
Zirconium and titanium, separation, 181.
Zirkelite, 86, 180.
Zoisite and epidote, 237.

ERRATA.

VOL. II.

PAGE	LINE	
63	19	*for* Parjkull *read* Paijkull.

VOL. IV.

65	9	*for* 109° *read* 101°.

VOL. VI.

164	13*	*for* fig. 1 *read* fig. 2.
165	1*	*for* XI. *read* IX.
202	8	*for* Weardale, Cumberland, *read* Weardale, Durham.

VOL. VIII.

172	16*	*for* $e\{001\}$ *read* $c\{001\}$.
184	7	*for* Ardbarrow Mine *read* Hodbarrow mine.
216	11	*for* 1 : 1 : 5613 *read* 1 : 1·5613.
	12	*for* 1 : 1 : 562 *read* 1 : 1·562.

VOL. X.

284	21	*for* Drigg in Cumberland *read* Dresden in Saxony.

VOL. XI.

2	15*	*for* analysis *read* analyses.
5	2	*for* XXVII. *read* XXVI.
10	9	*for* 8 *read* 7.
20	4	*for* acute angle *read* obtuse axial angle.
23	2* *(f. n.)*	*for* Castlenau *read* Castelnau.
32	12	*for* J. S. Talmage *read* J. E. Talmage.
44	10*	*for* Hy. Sjögren *read* Hj. Sjögren.
64	1* *(f. n.)*	*for* Calcium *read* Cæsium.
69	16*	*for* Éstesitö *read* Értesitő.

* From bottom of page.

VOL. XI.—*Continued.*

PAGE	LINE	
70	2	*for* 1877 *read* 1878; *add* Vol. XXXV.
	12	*for* I., 159 *read* I., 159, Ref.
	11*	*for* 1878 *read* 1879; *add* Vol. VII.
71	6*	*for e* 403 (Dauber?) *read e* 403? (Dauber).
72	14	*for* L 132 (Dauber?) *read* L 132? (Dauber).
104	10	*for* $2Mg_2B_4O_9$ *read* $2Mg_3B_4O_9$.
105	5*	*for* $3RO.SiO_2.R_2O_3.SiO_2$ *read* $3(RO.SiO_2).R_2O_3.SiO_2$.
106	17	*for* A. C. Lossen *read* C. A. Lossen.
144	18	*for* rocks *read* rock.
151	3	*for* pp. 389-122 *read* 389-4 2.
168	14*	*for* 471 *read* 473.
178	20*	*for* $FeO.Sb_2O_5+5FeO.TiO_2$ *read* $FeO.Sb_2O_5+5(FeO.TiO_2)$.
191	9	*for* 0·6376 *read* 0·6377.
209	8	*for* 1899 *read* 1896.

* From bottom of page.

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CONTENTS OF No. 53.

PAGE

On some British Pseudomorphs. By H. A. Miers, M.A., F.R.S., Professor of Mineralogy in the University of Oxford 263

The Identity of Andorite, Sundtite and Webnerite. By G. T. Prior, M.A., F.G.S., and L. J. Spencer, M.A., F.G.S., Assistants in the Mineral Department of the British Museum 286

On Tripuhyite, a new Antimonate of Iron, from Tripuhy, Brazil. By Dr. E. Hussak, of the Geological Survey of S. Paulo; and G. T. Prior, M.A., F.G.S., Assistant in the Mineral Department of the British Museum 302

Monazite and Xenotime in European Rocks. By Orville A. Derby, F.G.S., of the Geological Survey of S. Paulo, Brazil 304

On Blödite from the Punjab Salt Range. By F. R. Mallet, late Superintendent, Geological Survey of India 311

On a new occurrence of Apophyllite in South Africa. By J. A. Leo Henderson, M.E. 318

A List of New Mineral Names. By L. J. Spencer, M.A., F.G.S. 323

Abstracts 338

Notes and Comments 345

Obituaries. Gustav Adolf Kenngott..... 346
Samuel Haughton 346

Index 349

Errata 359

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